JPRS 75738

21 May 1980

Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 45

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available from Bell & Howell, Old Mansfield Road, Wooster, Ohio 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS 75738

21 May 1980

WORLDWIDE REPORT

NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 45

CONTENTS

WORLDWIDE AFFAIRS

Briefs

Spanish Reactor for Ecuador 1

ASIA

INDIA

Gandhi Tells House More Heavy Water Units Needed
(THE TIMES OF INDIA, 28 Mar 80) 2

PAKISTAN

Nuclear Energy Program Achieves Significant Progress
(Mohsin Ali; THE COMMERCIAL, Mar 80) 3

Enough Uranium To Back Up 8,000-MW Capacity
(ENGINEERING WORK, 21 Feb 80) 6

SOUTH KOREA

Briefs

Nuclear Power Project Modification 7

EAST EUROPE

HUNGARY

Hungarian Firms Producing Equipment for Nuclear Power Plants
(Katalin Bossanyi; NEPSZABADSAG, 20, 21 Mar 80) 8

CONTENTS (Continued)

WEST EUROPE

FEDERAL REPUBLIC OF GERMANY

Advanced Pressurized Water Reactor Studied
(HANDELSBLATT, 9 Apr 80) 16

ITALY

Opposition Voices Demands on Nuclear Power Plants
(Various sources, 1 Feb, 20, 24 Mar 80) 18

UIL Secretary General's Position,
by Giorgio Benvenuto
Opposition in Puglia
Opposition in Basilicata
Puglia Regional President's Position

Design, Construction Features of Caorso Nuclear Power Plant
(ENERGIA NUCLEARE, Jan 80) 26

SWEDEN

Government Gives Limited Operation Go Ahead to N-Plant
(DAGENS NYHETER, 2 Apr 80) 46

Nuclear Agency Orders Accident Study Before Loading
(DAGENS NYHETER, 3 Apr 80) 48

BRIEFS

SPANISH REACTOR FOR ECUADOR--Spain will build a nuclear studies center in Ecuador. Thirty specialists from both countries have been participating in this project. Said project includes a reactor for research and training of personnel and a laboratory for the production of radioactive isotopes. Alfonso Barrera, Ecuador's ambassador in Spain, yesterday gave the technical specifications for the project to the president of the Nuclear Energy Board, Lieutenant General Olivares Baque. The carrying out of the detailed plans for the reactor project will be awarded to Spanish engineering firms. The Nuclear Energy Board also heavily participates in the training of Ecuatorian personnel in the peaceful use of nuclear energy in this South American country. [Text] [Madrid EL PAIS in Spanish 18 Apr 80 p 47]

CSO: 5100

GANDHI TELLS HOUSE MORE HEAVY WATER UNITS NEEDED

Bombay THE TIMES OF INDIA in English 28 Mar 80 p 18

[Text] New Delhi, March 27: The Prime Minister told the Rajya Sabha today that it would be necessary to set up more heavy water plants to achieve self-sufficiency in this commodity for India's nuclear programme.

In a written reply to Dr Lokesh Chandra and Mr Mohammed Usman Arif (both Cong.-I), Mrs Gandhi stated that while the Nangal plant performance was satisfactory, that of the Tuticorin plant was affected by power failures, frequent interruptions in supply of synthesis gas from the fertiliser plant with which the heavy water plant is integrated, and labour trouble. However, production, which began in July 1978, has since improved and has commenced on a regular basis.

The heavy water plant at Baroda, started in July 1977, had to be shut down owing to an accident in December that year. Revamping and testing of the plant restarted on January 28 this year. The plant was expected to start regular production by April.

The Talcher plant was mechanically complete but testing and commissioning had been kept in abeyance because of acute power shortage in Orissa and the complete shut off of power to the fertiliser plant, which supplied the synthesis gas. The testing and commissioning work would commence as soon as regular power supply to the fertiliser plant is resumed, Mrs Gandhi said.

The Kota plant will begin production in November next year, a year after it is mechanically ready.

CSO: 5100

PAKISTAN

NUCLEAR ENERGY PROGRAM ACHIEVES SIGNIFICANT PROGRESS

Muscat THE COMMERCIAL in English Mar 80 Supplement pp 26, 27

[Article by Mohsin Ali]

[Text]

Cold statistics sketch the bleak energy scene in Pakistan today; and spotlight the need for all-out efforts to tap nuclear power if the nation is to lift the living standards of its 70 million people.

Experts rate Pakistan, in terms of the use of energy, among the poorest and the most under-developed countries of the world. In fact, this lack of availability of abundant and cheap power is the prime cause of the country's under-development and backwardness.

Pakistan's per capita consumption, for instance, is barely 0.2 Tons of Coal Equivalent (TCE) of energy and 150 Kwh of electricity — both of this constitute about 1/10th of the world average.

How absymally low the consumption is, is evident from the fact that in the United States, comparable figures stand at 12 (TEC) and 10,000 Kkh/capita, per year.

Further, the world's average consumption of electricity is 1500 Kwh per capita and even in Asian countries as a whole, the average consumption is about 300 units per year.

Moreover, even with regard to all the conventional sources of energy, nature has not been generous with Pakistan.

According to official estimates, the country's total gas reserves stand at 724 million TCE (TONS OF COAL EQUIVALENT): coal at 230 million TCE, in addition to being of poor quality, oil at 56 million TCE, and hydal power theoretically at 20,000 megawatts but only half of this i.e., 10,000 megawatts can be economically exploited because of the mountaneous terrain.

Thus the country's total known fossil fuel reserves of coal, oil and gas are so miniscule that these correspond to about one per cent of the world average per head and are equal to only 12 tons of coal per head.

This amount of energy is consumed in one year alone by an average citizen in the US.

And yet to rescue the masses in Pakistan from grinding poverty, the present per capita consumption of primary energy will have to go up four-fold by the year 2000.

To raise the present per capita consumption 160 Kwh to 800 Kwh by 2000 would require, in the view of experts, the installation of 27,000 MW.

And even if the country utilises its conventional sources to the maximum to produce 11,000 MW, a yawning gap of 16,000 MW would still remain.

This gap could only be filled by nuclear energy.

This is not only a Pakistani view.

The International Atomic Energy Agency (IAEA), the Vienna-based organ of the United Nations after an intensive study in 1974, also recommended that in view of the serious limitations of conventional sources of power, Pakistan should instal 16,000 MW of nuclear capacity by 2000 to fill its power needs.

An additional reason propelling Pakistan towards nuclear energy is the escalating price of oil. The country's oil import bill which stood at 64 million dollars in 1972-73 has soared to around 500 million dollars in 1978-79.

This accounts for around 40 per cent of the country's total foreign exchange earnings and constitutes about 25 per cent of the national budget outlay.

By 1985 it is estimated th ecountry's entire foreign exchange earnings will go towards paying the rising oil imports bill.

Power Stations:

To generate nuclear power and oversee the country's nuclear programme for peaceful purposes, the Pakistan Atomic Energy Commission (PAEC) was brought into being in 1959.

Its first 137 MW capacity plant, the Karachi Nuclear Power Plant (KANUPP) came on stream in 1972. Operated by Pakistani technicians, the plant meets 30 per cent of the power requirements of the Karachi area with a population of five millions.

A larger plant of 600 MW capacity is now being built on the bank of the Indus river near Chashma in the North-West Frontier Province. The multimillion dollar power plant, expected to be operational by 1983, will augment electric supply in the northern grid of the country, now humming with light and heavy industries.

Following the Chashma plant, the country will need one nuclear power plant every alternate year, letting the share of nuclear power grow from the present 137 MW to 1340 MW in 1985, to 4940 MW in 1970, and to 15,935 MW in 2000, when the total generating capacity is planned to be raised to 26,400 MW.

Nuclear Medicine:

Side by side, Pakistan is using nuclear know-how and technology to combat diseases, step up agricultural productivity, prolong the storage life of foodgrains and fruits, aid the search for minerals and produce a corps of skilled nuclear scientists and technicians to push research forward to improve the life of its people.

Six nuclear medical centres for example are in operation today in the hospitals at Karachi, Jamshoro, Larkana, Multan, Lahore and Peshawar.

Equipped with modern nucleonic instruments, radioisotopes, radiation units, and manned by highly qualified physicians, these radio-medical centres are treating thousands of patients suffering from goitre, leukaemia, cancer, congestic cardiac faiure, angina pteoris, renal calculi, hapatitis etc.

In many cases the diagnostic and therapeutic procedures based on radioisotopes techniques and radiation sources have proved life-saving.

A most modern Institute of Radiotherapy and Nuclear Medicine (IRNUM) is being set up at Peshawar with a 42-bed hospital.

Similar nuclear medical facilities for the province of Baluchistan will also be provided when a Centre opens in Quetta's Bolan Medical College.

Agricultural Research:

Likewise, to beef up the agricultural sector, the Nuclear Institute for Agriculture and Biology (NIAB) was set up in 1972 at Faisalabad (formerly Lyallpur), to provide facilities in the use of atomic radiation and radioisotopes to scientists working in diversified areas of abricultural and biological sciences.

Sprawling over 200 acres of farm land, the Institute, apart from research, arranges lectures and practical courses for the M.Sc., and Ph.D., students of the nearby Agricultural University of the Punjab.

The Institute is also carrying on research aimed at improving the genetic characteristics of wheat cotton and rice, the country's three main crops.

Also in prolonging the storage life of foodgrains and perishables by the use of ionizing radiation and other methods; and in fighting pests, and improving soil and farm productivity.

The Atomic Energy Agricultural Research Centre at Tandojam near Hyderabad in the province of Sind, established in 1963 is carrying on studies on the application of gamma irradiation on such disciplines as plant genetics and breeding, plant physiology, soil science, entomology and microbiology. The Centre has evolved high-yield varieties of rice.

A Nuclear Institute for Food and Agriculture is also being established at Tarnab is Peshawar in the North-West Frontier Province of Pakistan. It will concentrate on the improvement of the sugar-cane, fruit and tobacco crops grown in the area.

Institute of Nuclear Science:

To implement Pakistan's programme of the peaceful uses of nuclear energy and to provide research and training facilities to scientists and technicians, the Pakistan Institute of Nuclear Science and Technology (PINSTECH) was established in 1965.

CSO: 5100

PAKISTAN

ENOUGH URANIUM TO BACK UP 8,000-MW CAPACITY

Calcutta ENGINEERING WORK in English 21 Feb 80 p 15

[Text] The current uranium resources within the country are estimated to be capable of supporting a first stage nuclear power programme of about 8,000 MW installed capacity of uranium reactors.

Of the 34,000 tonnes uranium resources (U 308) in the country, 15,000 tonnes are considered economically exploitable at current international prices.

Estimates of additional resources are placed at 27,000 tonnes of U 308.

Disclosing this, a report of the official working group on energy policy says that it may be possible to support a larger programme of first stage reactors if the present exploration programmes yield other viable sources.

The report expressed optimism that with the eventual introduction of fast breeder reactors in the subsequent stages, increased capacity can be supported by even the known reserves of uranium.

The most important deposits of uranium ore are located in the Singhbhum region of Bihar. New target areas have recently been identified in the crystallines of Madhya Pradesh and some significant uranium deposits have been discovered. Exploration efforts have revealed uraniferrous zone in the precambrian conglomerates in Rajasthan and structurally-controlled uranium deposits in parts of Central India.

India has one of the largest reserves of thorium contained in the monazite deposits along the sea board and in inland places.

The deposits are expected to yield 363,000 tonnes of thorium oxide.

When thorium-fuelled reactors are constructed in subsequent stages of the nuclear programme, this resource base can support a very large capacity for a long time, the report says.

CSO: 5100

BRIEFS

NUCLEAR POWER PROJECT MODIFICATION--The government plans to undertake an overall modification of plans for the construction of nuclear power plants in connection with the nation's long-term power source plan. Energy & Resource Minister YANG Yun-se said on Apr 23 that "The Korean government, through consultations with concerned ministries, will review the overall matter related to nuclear power generating, except the question concerning the construction of Nuclear Power Units 9 and 10." Minister YANG made these remarks when he received a courtesy visit from Jean-Claude LENY, president of Framatome, who is currently visiting Korea as a member of the French business delegation. [Text] [Seoul CHOSON ILBO in Korean 24 Apr 80 p 2, Seoul U.S. Embassy Translation]

CSO: 5100

HUNGARY

HUNGARIAN FIRMS PRODUCING EQUIPMENT FOR NUCLEAR POWER PLANTS

Budapest NEPSZABADSAG in Hungarian 20, 21 Mar 80 p 5

[Article and Interviews by Katalin Bossanyi: "New Manufacturing Branch Established]

[20 Mar 80, p 5]

[Text] The peaceful domestic use of nuclear power is already a reality today. The entire country can watch the construction of the Paks Nuclear Power Plant and, in addition, there is also a possibility through the bi- and multilateral specialization of the CEMA-countries for our machine industry to become part of the domestic production of nuclear equipment, which is a new production branch that includes a quality change in technology.

We Are Delivering More and More

The Soviet Union has the most extensive experience in the design, organization and construction of nuclear power plants and thus, understandably, domestic investors wanted us to buy the Paks Nuclear Power Plant in turnkey condition. However, it became apparent in time that the Hungarian machine industry, in addition to carrying out the work of construction and installation, is capable of meeting the exceedingly strict technology and quality requirements even in a much broader area and thus can deliver more and more equipment, individual machines and appliances to Paks and to the nuclear power plants being constructed in the other socialist countries.

Hungarian enterprises already supply 30 percent of the machines at Paks and this ratio may be expected to increase.

[Question] "What is the significance today of our machine industry's presence?," I ask Attila Lorinczi, official of the Ministry of Metallurgical and Machine Industries.

[Lorinczi] "The Metallurgical Plant Construction Enterprise, the Danube Iron Works and the Ganz-Mavag supplied most of the steel structures. Not only their production and assembly but also their transportation was a special task: they had to be carried on special trailers and needed especially heavy-duty cranes unknown in domestic investments to date. But all of this is only the framework of this exceptional work. We are doing well in the development of auxiliary establishments and also various machines and equipment are also continually arriving."

In looking around the buildings under construction, the data for illustrating the fantastic dimensions could be cited at length, but the layman loses his sense of proportion at such a large project, not having a point of reference and seeing only that an unbelievable amount of material and physical and mental work is needed to carry out the tasks here. But I cannot resist to disclose at least the dimensions of the extraction plant. This huge concrete "cube," which is erected in front of the changed face of the Danube's branch at Paks, the water reservoir and the fish pond to be built that will use the warm water of the nuclear power plant, produces in a day exactly as much as Budapest's daily water consumption (the pumps reflect the good work at the Ganz-Mavag). My escorts add right away that the water returned to the river is clean, and the nuclear power plant environmental pollution is less than that of a conventional power plant.

We are entering the "empire" of the Plant and Machine Assembling Enterprise [GYGV]; where more than a 1,000 employees are assembling the various technological levels of the 70-meter tall main building. The plumbers, all wearing white robes, are at work now at the main circulating system, which may also be considered as the artery of the nuclear plant. This also shows how much cleanliness and disciplined work, to the second exactness, is needed by the task here.

Rusting--Danger of Radiation

[Varo] "The weldings must be done and covered in such a way that oxidation cannot take place," explains Janos Varo a welder. "For if even the smallest surface would begin to rust here in the active zone, cobalt particles would be freed. This is the reason why we must make no mistakes. And since this is humanly impossible, control plays an especially important role. Every single welding is checked by various methods. Just think: here where we are standing there are alone 100,000 weldings!"

Gyorgy Posa, director-general of the GYGV says: "Our people have been helping in the construction of the East German NORD nuclear plant since 1972; it was here where they learned the special welding techniques and later the practical master strokes. The 120 specialists are directing and organizing our work at Paks. In addition, our workers are also trained in assembling nuclear reactors and turbines. Mass training is already taking place continuously here at home. We already have 736 trained welders, and 80 of them already have a diploma proving that they are qualified to weld nuclear plant materials. In the next months, they will be the ones who will occupy the key positions at Paks.

[Posa] "It is especially promising for the enterprise that those who have done specialty work here already possess tomorrow's technological know-how. All of this gives the enterprise invaluable professional opportunities in other tasks as well."

[Question] "How much does a trained welder earn for this work?"

[Posa] "The enterprise average is 46,000 forints a year and those working at Paks make as much as 53,000 forints."

The GYGV-team is a well-organized and flexible group. They were the first among the assembling enterprises who started working in four shifts; this means that they work 8 days and have 4 days off. Last year they speeded up the work on this large investment by not adhering strictly to their pre-planned work-schedule but, because of shortages of imported materials and delays in the arrivals of equipment, re-programmed their tasks daily. They meritoriously helped out other enterprises and thus we can say only good things about them. They established a plant for pre-fabricated pipes which increases the efficiency of the assembly here. This year they will be even more in the center of attention as 1980 is the year of the assembly!

We are entering the area of the reactor room at the height of 18 meters. We notice the two huge cranes right away. The cassette reloading equipment will be standing here above the reactor tank.

It Works Only Once a Year

"We began manufacturing them according to Soviet designs; the first one must be finished this year, with a short deadline," says Andras Dunajszki, director-general of the Ganz-Mavag.

[Question] "What does this strange machine do?"

[Dunajszki] "Although it is considered an auxiliary investment, it has a key role in the operation of the nuclear plant. True, it "works" only once a year for a month: it re-shuffles the cassettes in the reactor that are gradually burning out, being full of isotopic heating fuel; it lifts out the used ones and puts in the new ones. Understandably, living humans cannot enter this room! For this reason, the 15-meter long telescopic manipulator that moves the cassettes, a precision equipment having many thousands of parts, is operated and controlled by a television monitor. It must do a very exact job, that is, it has complex instruments. The electronic equipment is made for us by the United Electrical Machine Factory.

"The drained cassettes are put into a huge reservoir filled with water where, according to the new Hungarian laws just passed recently, they will be stored for several years and then will be transported back to the Soviet Union. The radiation-proof container was made by the Lang Machine Factory, which also made the heat exchangers for the nuclear plant's secondary circle and various acid-proof containers."

[Batyi] "According to the Soviet inspectors, we did first-class weldings. They thanked us in a special letter for our speedy work," says proudly Janos Batyi, the Lang Machine Factory's technical deputy director. But there is a wish behind his words that the enterprise, which has an extensive background, played a bigger role in the Paks investment! He brings up, indeed, the old dream of the Lang Machine Factory: "Our turbines are also suitable for nuclear plants. We are ready with the plans and would be able to make blocks of even 1,000 megawatts."

The Paks plant is being built at present with Soviet turbines. The assembly of the feeding units connected to the 220-megawatt turbine was recently started by the April 4 Machine Industrial Enterprise. Gyorgy Toth, director-general, speaks of the delays of imported materials that hinder continuous work, also mentioning that continuous assembly was made difficult last year as well as this year, by the fact that their working place was still occupied by another enterprise. This was to which Attila Lorinczi, official of the Ministry of Metallurgical and Machine Industries, said:

[Lorinczi] "The coordinational network plan, which includes the tasks of the various enterprises in monthly break-down, was ready in early March. This is important for us, among other things, for the machine industry's presence in this large project is continuous although, of course, the proportion and pace of the work change from year to year."

Three-fold Security

The VVER 440 nuclear power plant under construction at Paks is considered basically a prototype. Although there are several nuclear plants of similar system operating in the Soviet Union and the neighboring socialist countries, the novelty of ours lies in the three-fold security system! D.P. Novikov, chief adviser in economic cooperation at the Soviet Union's embassy in Hungary, expresses his opinion about this as follows:

[Novikov] "We are satisfied with the work of the Hungarian machine industrial enterprises delivering components to Paks; a majority of them deliver equipment, on the basis of the bi- and multi-lateral interstate contracts, to other nuclear plants as well. I think that the Paks project is progressing adequately. The nuclear plant at Rovno, Ukraine, which is similar to the Hungarian plant but is further developed, will be finished this year. Thus our Hungarian partners are able to gain from the experiences there.

Benefits of CEMA Cooperation

[21 Mar 80, p 5]

[Text] One of the economic syndicates of the CEMA-countries is the Interatomenergo, created in 1973. The Hungarian "representative" of the syndicate, which is operating as an enterprise and the headquarters of which is in Moscow, is the Chemimas Chemical Machine Planning and Main Assembly

Enterprise, and its director-general, Miklos File, is at the same time also the secretary of the government committee that coordinates the manufacture of nuclear machines.

Organized by the INTERATOMENERGO

[File] "The main activity of the Interatomenergo has been, until now, centered around international specialization of manufacture and the preparation of cooperation. Its task is to develop requirements of quality and standards of new manufacturing branches that signify tomorrow's technological level, to explore the capacity of the member states, to organize specialized deliveries of materials and part units necessary for nuclear machine manufacture, to research and develop new groups of products, and to purchase licenses and manufacturing processes. The syndicate will in time undertake mutual developments as well. At present, however, we are still concentrating on preparation and organization, the national member enterprises applying Soviet documentations and plans locally. This was thus in recent years the primary task of the Cheminas as well while, at the same time, taking care of organizing domestic manufacture and creating the conditions for exporting."

For multilateral specialization of manufacture was in most countries preceded by and founded on bilateral interstate agreements. The agreement between the Soviet Union and Hungary, according to which we delivered between 1975 and 1980, based on Soviet documentations, 55-60 million rubles worth of nuclear machines and equipment, was made in late 1974. A smaller part of the exports is made up by conventional electrical equipment, made and developed by the Ganz Electrical Plant, which may also be used for nuclear power plants, but there is also a possibility to manufacture special containers and individual machines that were not manufactured earlier by the Hungarian industry. The various heat exchangers, ion exchangers and filtering equipment are made by the April 4 Machine Industrial Enterprise.

[Bodor] "This profile was introduced at the former chemical industrial machine factory at Kiskunfelegyhaza, for well-trained specialists, who were able to weld acid-proof steel that is indispensable in the manufacture of nuclear machines, worked only here in larger numbers," explains production manager Janos Bodor. "Based on this specialty kernel, the product structure of the Kiskunfelegyhaza plant has completely changed, nuclear equipment constituing 70 percent of our production today."

There Is Still Room For Improvement

According to V.G. Glasov, the Soviet quality control organization representative in Hungary, those in Kiskunfelegyhaza are doing an outstanding job, although there is still room for improvement in the organization of production and quality control.

[Szabo] "Unfortunately, the deliveries piled up in the last years of the plan period," continues Lajos Szabo, technical deputy director. "Since we could not prepare for such a sudden increase of production, the Ministry of Metallurgical and Machine Industries included other enterprises--such as the Lang Machine Factory, the Vegyepszer, and the Transdanubian Petroleum Industry Machine Factory--in the manufacture and exporting of large containers as well."

[Question] "Is this new branch of manufacture economical?"

[Szabo] "Indisputably. Our specific prices are more favorable than that of an NC-machine. From a national economic standpoint, our ruble production may also be considered good. The increase of production has only one disadvantage, namely, the large proportion of imported materials. We are trying to solve this problem by classifying a few special kinds of steel together with the Danube Iron Works. In addition, we are striving to make cooperational business deals with our capitalist suppliers of materials.

"According to our earlier concepts, a larger project would have been realized at Kiskunfelegyhaza in the present plan period but, according to the signs, this will be protracted.

"Our investment proposal was denied in 1978 by the National Bank as it was not yet certain then how fast the manufacture of nuclear machines will grow in the following years. Since then, however, multilateral specialization was established between the CEMA-countries and thus the bank requested us recently to work out a new development proposal. And, under a guarantee by the Ministry of Finance, we could already start with the acquisition of a few very much needed machines."

[Question] "On the basis of multilateral specialization, what tasks is the enterprise facing?"

[Szabo] "We have unbelievable possibilities! Until now, we have delivered equipment for the various nuclear plants one by one, and now are manufacturing and further developing complete water operating circles. This is a huge step forward. We have recently established a mutual developing syndicate with the GAMMA, which makes precision instruments. A West German company also joined the syndicate: we purchased chemical water technology from them. I personally expect a great deal from the unfolding of systematic development. Although the manufacture of nuclear plant equipment is in itself good business but its character is such that it gives an opportunity only for small or medium-scale production. On this basis, however, we are already able to manufacture any high-quality chemical processing equipment! This is the real and foreseeable advantage of this program."

The CEMA-countries, in addition to the Soviet Union, will build a network of nuclear plants in the next 10 years, producing about 37,000 megawatts of energy. One of the conditions of realizing this huge project was the multilateral product specialization in manufacturing nuclear equipment. The agreement was signed by the member states in 1979.

Rapid Preparations

Says Dr Janos Heiczman, Deputy Minister of Metallurgical and Machine Industries:

[Heiczman] "Hungary has no interest in manufacturing the reactor's main units. Primarily, we strived to prepare ourselves for the long-range manufacture of products that do not require large investment sums and materials but rather those built on the existing industrial base. Thus we specialized in products that have less weight and value, that are more complex and precise and that require more intellectual investment. Such are, for example, the various special machine tools, which are suitable for the repair and maintenance of reactors and steam generators, servicing and manipulating equipment, complete water treatment loops, control consoles, and heat exchangers."

[Question] "To what extent do we participate in this broad international program?"

[Heiczman] "In the next 10 years we will ship about 600 million rubles worth of nuclear equipment to the Soviet Union and the other socialist countries. According to the agreement, our enterprises participating in the manufacture of nuclear machines are classified separately. And those which earn this special status can compete in any country, not only in this area but also in that of the most up-to-date machine manufacture in the chemical, heavy machine and food industries. It is worth to know how our enterprises prepare themselves for this program, which is interesting both as far as technology and the economy is concerned and which means a beautiful task. We have already referred to essence of the Ganz-Mavag's cassette reloading equipment. Andras Dunajszki, director-general, is acquainting us with the conditions of organizing the manufacture.

"We have established a special department of development for the domestic application of Soviet technology. We have just received the plans that were up-dated along-the-way, and in a few months we must build the Paks prototype of the cassette reloader. In the next 10 years we will manufacture 50-60 such complex machines for the other socialist countries."

[Question] "Does the cassette reloader require an investment?"

[Heiczman] "We were able to include it in our reconstruction program, for this is one way to economically change a product. We purchased a few special processing machines and reconstructed our large hall with the help of the Shaft Construction Enterprise."

The Lang Machine Factory moved its industrial food complex to its regional plant and thus it made room in its main plant in Budapest for nuclear equipment.

[Question] "In addition to heat exchangers, what other products do you manufacture?," I asked Janos Batyi, deputy director-general.

[Batyi] "We make huge containers and steel structures needed for the nuclear plant's security equipment, including, for instance, that huge steel cloak in which the reactor is placed during repair." Janos Batyi also added that the heat control technology is deficient in almost all of the large domestic enterprises which take part in the program. Through the present potentials for development, there is no possibility for individual investments however, they would get further ahead if they united.

On the basis of multilateral specialization, the Special Machine Factory of the Csepel Works manufactures lifting equipment and repairing and assembling machines. Albin Keresztes, the economic manager, says:

[Keresztes] "A 5-million forint project is being finished at our heavy machine plant at Kaposvar. This plant will make special drilling equipment. These machines will repair the pipes of the heat exchangers in the radioactive zone. A TV camera guides the machine to the defective pipe, which then drills and welds it. It must work with millimeter precision. In addition, we also manufacture machine tools for tightening the bolts on the reactor's cover."

According To The Earlier Pace

In addition to the special enterprises mentioned, the Ministry of Metallurgical and Machine Industries is including in the program other factories as well and thus, through internal cooperations, the enterprises can prepare for next year's increased deliveries with smaller investments and more flexibility.

The opinion of D.F. Novikov, chief adviser, and V.V. Kulikov, representative in Hungary of the Atomenergoexport, about the Hungarian applications to date and about the quality of work done by Hungarian factories is favorable. It may also be added that we have overcome the initial hurdles of documentation exchange, although a closer cooperation between the Soviet planners and Cheminas will continue to be necessary. They emphasized that the nuclear power plant construction program planned for the next decade is being realized according to a pace set earlier and thus the enterprises taking part in the specialized manufacture of machines have an adequate market background, and their production program is easy to organize.

9414
CSO: 5100

ADVANCED PRESSURIZED WATER REACTOR STUDIED

Duesseldorf HANDELSBLATT in German 9 Apr 80 p 21

[Article: "Uranium Used Well Even Without Rapid Breeder"]

> [Text] The experts still do not appear to have found the best possible concept for energy supply by means of nuclear energy for the FRG. The straight-line path from the generation of light water reactors directly to a uranium-conserving generation of sodium-cooled rapid breeders no longer needs to be viewed as the main objective, as was recently made clear at the Reactor Conference '80 of the Nuclear Society and of the Atomic Forum in Berlin.

The nuclear research center in Karlsruhe (KfK) reported on studies of a so-called advanced pressurized water reactor which could contribute to a considerable conservation in nuclear fuel stocks as a result of a high conversion rate--that is, the capacity to produce the nuclear fuel plutonium 239 from Uranium 238.

The special advantages of this reactor type exist, on the one hand, in the full use of the presently used pressurized water systems and the established light water reactor technologies and, on the other hand, in a relatively short-term realization capacity. The technical prerequisites for realizing this reactor type were studied by the KfK together with the Kraftwerk Union [KWU].

Based upon American experiences in the 1970's with the Shippingport Reactor, a study was made opening the possibility for converting existing pressurized water nuclear power plants accordingly. Whereas the American experiences were based upon the thorium-uranium 233 nuclear fuel cycle, in the present study the uranium-plutonium nuclear fuel cycle already used today in light water reactors was investigated. The results of the Karlsruhe researchers show that conversion rates of 0.9 percent or more can be expected by using an enriched nuclear fuel of 7 to 7.5 percent plutonium or 8 percent uranium 235 instead of the previously common 3 percent and by using a considerably more dense fuel rod packing. With this, the utilization of fuels could be increased five-fold by increasing the production of plutonium in today's light water reactors.

The study had the following objectives: use of commercially available light water reactor technologies, the conversion of plants already in operation, and the sue of an established nuclear fuel cycle including the reprocessing of burnt-out nuclear fuels.

The following problems, which are supposed to be solved by KfK as part of a multiple-year development program with the KWK, were identified as those which still have to be overcome for the technical realization of the reactor type: guaranteeing an inherently stable regular behavior of the reactor by a sufficiently negative coolant coefficient; assuring the removal of heat even in the case of accidents; assuring the reintroduction of coolants to the reactor core after there has been a loss of coolant due to an accident; as well as a reliable operating behavior of the fuel elements at high levels of burning.

Previous strategic considerations assumed that an optimal utilization of fuels results only from the combined use of light water and breeder reactors. The new considerations, however, show that similar fuel conservation can be achieved by a combination of rapid breeder reactors and advanced pressurized water reactors.

The advantage of being able to use the known light water reactor concept at higher conversion rates for a considerable portion of the reactor plants is dampened by the disadvantage of not being able to achieve import independence in the nuclear fuel field for a number of decades hence because the plutonium formed in the light water reactors would not be used exclusively for fueling fast breeder reactors. As stated guardedly by the Karlsruhe experts, the pressurized water reactor would be no competition to the fast breeder reactor which will become effective over the longer run. But it could already contribute to better utilization of uranium for the near future, they assured.

9527
CSO: 5100

OPPOSITION VOICES DEMANDS ON NUCLEAR POWER PLANTS

UIL Secretary General's Position

Rome LAVORO ITALIANO in Italian 1 Feb 80 pp 6, 7

[Article by Giorgio Benvenuto: "When There Is a Deep Ravine at the Bottom of the Shortcut--Nuclear Safety: From Venice, an Insufficient Reply With an Inadequate Method--the Speech by the Secretary General of the UIL (Italian Union of Labor)"]

[Text] The reasons for the crisis in which, for some time now, this country has been struggling are by now well-known. They are structural reasons, as is now said, with an abused term, and I believe that we all agree on this point; the differences, such as they are, have to do with the responsibilities of the social and political personages who by their choices and behavior combine to form the decisions. But what seems curious and singular in the Italian matter is the fact that the groups who run things, far from resolving the dispute about who is most responsible for the troubles we are going through, show a great capacity for continually reshuffling the cards on the table without any concern for the fact that the table is tottering and risks crashing to the ground. The important thing is that the game continue and that there always be new spectacular entrances onto the stage. But to get away from metaphor: it is true that there is a crisis and that it is a deep one, but it is also true that if it were resolved, an entire social and intellectual class would go into crisis in its turn. And this class probably coincides largely with the groups that run this country. It lives and vegetates in the "culture of crisis": it needs it like bread, because only in it does it safeguard its own survival. It has in a way constructed the rules of the game of a gigantic "alley economy," and it needs the phenomenon to be analyzed, studied, discussed and also criticized from every point of view. But the fundamental condition is that it not be removed. Otherwise, what would the sociologists, the economists, the cultural anthropologists, the wizards, the electoral errand boys and the demagogues do? The important thing for all these people to to keep going in some way. The underground economy has one great value: it hides the problems too, and thus one does not run the risk of anyone's solving them.

The great ally of this black market in which the culture of crisis rages is naturally nongovernment. And this alliance, which is the effect of a considerable but circumscribed crisis, is becoming the cause of a far greater and far less comprehensible crisis. I wanted to present these reflections as a foreword, thinking about two affairs that directly or indirectly have to do with the problem which this conference is discussing.

The first is of immediate relevance, and concerns the way in which the relationship with Confindustria [General Confederation of Italian Industry] on the problem of energy is advancing. No more than a month ago, Confindustria woke up from a long lethargy and proposed three-way meetings on the problem of energy policy. We reply that this is an excellent thing, because it finally enables us to emerge from vagueness on so important and decisive a question. Thus we got to the point of announcing to the president of the council, with a great many joint letters, that the social parties will first discuss between themselves and would then ask to talk about it together with the government. The meeting was held in great pomp, but Confindustria stragely came forward with a document full, as usual, of macroeconomic projections with which it was desired to demonstrate that either the relations between the social classes are modified, through reduction of real pay, or else it is useless to talk about all the rest: that is, about energy. All this is hallucinating, but the important thing for Confindustria is to gain time. And for us, to note another missed opportunity.

Not dissimilar is the mechanism that led to this national conference. You will recall how the proposal was born: as the ideological (and not only ideological) guerrilla warfare on the nuclear question got rougher, we proposed that the government call a national conference on energy, in which all the social parties would be fully involved, so that the terms of this question might be clear and the premises for operative decisions could thus be created. At that point, everyone would have taken on his own responsibilities. For us, holding such a conference would have meant agreeing to discuss seriously a real national energy plan, in which the problem of nuclear safety is obviously only one aspect. Our proposal was incorporated into the economic program of acting president Craxi, and once that attempt was exhausted, it was carried over, in an abridged form, into Cossiga's program. Thus, a political proposal was transformed into an administrative juggling act. Discussing the offshoots of a problem is like taking it for granted that the problem should not and cannot be solved. The important thing here is to gain time--until the municipal elections, if possible. How could you think that the Christian Democrats have the least intention of making choices in this area before the film "The China Syndrome" is taken out of circulation?

I believe that this manner of proceeding is frustrating both for us, who want to have all the elements of the energy question and who have great uncertainties about the nuclear choice, and for those sectors of the industrial culture who have been directing their work and their research energies toward this choice for years.

In the search for this shortcut, the fact that too much cunning ends by boomeranging back onto those who use it was not taken into account. I have great respect for all the members of the Salvetti committee, but the operation that was carried out with the establishment of this committee is frankly not acceptable. It was an attempt to combine scientific respectability with political pluralism so that the outcome would not be subject to doubt, though at the same time a certain internal dialectic could not be denied. In a few months (too few, no one can honestly deny), the effect was achieved. But it seems to us that it was a very skimpy operation.

And let us speak the truth: to whom is it of any use except to the champions of nongovernment and of the logic of putting-off? I believe the fact should be noted that there has been a profound renewal of methods and of men (for their quality and probity) at the head of ENEL [National Electric Power Agency] and of the CNEN [National Nuclear Energy Commission]. But I ask myself and I ask them: what results do they think will follow from the fact that ENEL and the CNEN, which are institutionally interested in the nuclear choice, are guaranteeing to themselves that the construction of nuclear power plants is an excellent thing? Is it possible for a magistrate to be able to judge serenely a case that involves himself or his own relative?

It is therefore obvious that the Salvetti committee is destined to bear the burden of the ambiguity of the political logic that has generated it. I would like to emphasize clearly that this is not a clear and determined pronuclear logic, but simply the logic of the putting-off of any decision. In the attitude of some, its results serve to insinuate the doubt that maybe this "Chinese syndrome" is not so serious as it seems, and that between one film and the next, the debate goes forward. The fact that energy policy is not going forward is quite another matter. Of course, it is true that the commission set up by Carter (and instituted with very different political guarantees) has set some serious conditions on continuation of nuclear enterprises after the Harrisburg incident; and it is likewise true that licensing for putting new plants into service has been suspended for 1980. But it is also true--some will think-- that the world is beautiful because it is various.

In any case, the guarantees that the trade union had particularly insisted on were not given attentive analysis, and exhaustive replies to the questions that we had posed did not come.

Indeed, they remain open: the problems of the maturity of the nuclear industrial system--that is, of the reliability of the electromechanical firms; the question of the tendency to express the impact and the health and environmental consequences in money terms--a tendency that is emerging on the international level and that has already found some diligent spokesmen in some ministries, naturally with the clearest opposition from the trade union; the specific problems relative to the capacity of the Italian economic system to cope with the questions connected not only with production but also with management of nuclear electric power plants.

The legislative instruments are outdated and bureaucratic and correspond to the outlook of the small plants of the 1960's. At Caorso, the contract-letting for construction of the power plant went to 18 stages, and this is not the only serious difficulty that has occurred in the building and management of that installation.

Every formal public guarantee collapses in the face of the knowledge of what the effective availability is for the means, men, and organization capable of honoring those guarantees. Furthermore, the inaccurate knowledge of the environmental characteristics and the structural deficiencies in this regard --one thinks of the declarations made several times by the geologists--constitute one of the most obvious examples of the difficulties of being able to really provide those guarantees.

As is known, instruments for furnishing guarantees are provided for by the still insufficient rule-making procedure. I refer, for example, to the Interministerial Council for Coordination and Consultation, which is supposed to carry out functions in the field of health and environmental safety. One might ask oneself, in this case, why this council has never been activated: it has not met for several years, but it could have furnished some kind of continuity of information, probably not suspected of partiality, to the Salvetti committee itself.

But these are only a few aspects of the problem that I wanted to clarify and which others will certainly expand upon with greater attention. What I want to stress is the political dimension of the overall problem of energy policy, of which the problem of nuclear safety is only one aspect. We are ready to face the problem as a whole with full and direct responsibility, but we want it to be clear that what is involved is not just a technical problem but a question that speaks to the very nature of our country's democratic system.

But it is necessary for everyone to do his part thoroughly--in the first place, the government, which cannot delude itself by thinking it can hide behind the limitations and ambiguities of fact with which this conference is burdened and put off once again any political desire to face seriously the problem of working out a real national energy plan. Secondly, Confindustria, which may not delude itself by thinking it can go on with the three-card game with any credibility: let the dialog be resumed in a serious manner, and as for us, we are ready to come to a three-way meeting that could have a truly operative character, but always on the principle, naturally, that the decisive word is up to Parliament.

But we have the duty, nonetheless, to speak out unequivocally to those sectors of industry and of the culture that are heavily penalized by the protraction of this situation of uncertainty. They can and should count on our good faith and on our trustworthiness as political interlocutors. We have the necessity, in addition to the duty, of establishing with them relations of full faithfulness and mutual trust: they must know that we have no interest in seeing a great patrimony of culture and of creative and administrative capacity sacrificed. We are prepared to face with them, step by step, the difficulties that already exist and that will arise. For us, the nucleare question is not reducible to an ideological referendum of pros and cons.

Our desire to understand in order to be able to reach decisions together is certainly stronger than any dilettantistic urge to oppose. And this is a common datum that this initiative too can restore to us. The rest is a question of political will and of making a system of democracy function as it should.

Opposition in Puglia

Bari GAZZETTA DEL MEZZOGIORNO in Italian 24 Mar 80 p 4

[Article: "Controversial Document after an Assembly--Italia Nostra Is Against the Nuclear Choice in Puglia--a Regional Energy Plan Based on Accurate Forecasts of Future Consumption Is Called for--'No' to the Coal-Fired Power Plant at Taranto"]

[Text] The Puglia regional council of the Italia Nostra [Our Italy] association, after a broad and far-reaching discussion of the problem of nuclear or coal-fired power plants probably to be built in Puglia, has confirmed its earlier decisions against the so-called "nuclear choice" and has made the most forceful protest--as stated in a communique--against the Assembly of the Puglia Region for being the first and only one of all the Regions of Italy to make hasty decisions, not taking any account of the desire of the local administrations, the destiny and purposes of the territories involved in the siting of the nuclear power plants. In addition, it denounces the practice, established for some time now, of concentrating in the hands of the CNEN the handling of and jursidiction over all the nuclear problems, removing them from the jurisdiction of other bodies--first of all, the Higher Institute of Health.

As regards the possible construction of coal-fired power plants, Italia Nostra expresses on a preliminary basis its own opposition to construction of megaplants which inherently bring high pollution rates.

It therefore asks: that before new power plants are talked about, there be studies toward a serious regional energy plan, based on accurate forecasts of future consumption, to be presented clearly to public opinion; that planning for construction of any new power plant be initiated only if the plant is recognized by said plan as being useful and necessary; that before going on to the construction phase for any such power plant, an "environmental impact" study be made, and that all the work that may prove necessary in order to eliminate any possible negative consequences of said impact be planned for, especially as regards pollution; that such work be financed before the work relative to the power plant, and that it be carried out before or simultaneously with construction; that the problem of professional retraining of the skilled workmen and the technicians be faced at once, with the institution of occupational schools (or strengthening of the existing ones), so as to be able to prepare the skilled workers in time; that on account of the interests of the social groups that it represents and the institutional goals that it pursues, the Italia Nostra Association be designated as the natural interlocutor for the Puglia Region.

Finally--the document concludes--as regards the coal-fired power plant planned for Taranto, the regional council of Italia Nostra calls the attention of the competent organisms to the already deteriorated environmental situation that makes, as has already been demonstrated by authoritative scientists, even the installation of new industrial plants with low pollution rates incompatible, not to mention the precarious state of the territory's historical and artistic patrimony, especially the cliff frescoes, which are irreparably condemned to fast deterioration because of alteration of the environmental balance through the pollution produced by the existing industries.

Opposition in Basilicata

Bari GAZZETTA DEL MEZZOGIORNO in Italian 20 Mar 80 p 8

[Article: "The Protest Takes Shape--No to Nuclear--General Strike in Stigliano--the Town Council in Permanent Session"]

[Text] Stigliano (G.de Sanctis)--The state of agitation over the installation of a nuclear plant continues in Stigliano. A democratic committee has been set up in Stigliano for defense and development of the inner areas, and all the parties have joined it, with attorney De Lucia representing the DC [Christian Democratic Party]; Prof Rienzi, the PCI; attorney Del Monte, the PSI [Italian Socialist Party]; and Bisignani, the PSDI [Italian Social Democratic Party]; as well as the representatives of the various social groups--craftsmen, merchants, [illegible], of the schools, and for the clergy, Father De Santis.

Among the many initiatives proposed, a general strike was decided on today, in confirmation of the opposition to installation of the uranium and plutonium plant in Basilicata, and particularly, in the area of Stigliano.

The opposition is not unfounded and irrational, which is the idea that some want to propagate, but an opposition urged on account of the enormous risks that the installation would involve. Above all, the safety conditions for protecting the health and safety of the populations concerned do not exist.

As regards the plutonium, Parliament must express itself. In addition to these motives of a general nature, there are others that touch the Stigliano community very closely--specifically, those that relate to the incompatibility of the installation and the agricultural development of the zone chosen, as well as the urban development of the residential district.

At the conclusion of the demonstration--called, as was said, for today--it was decided that a delegation should go to Potenza to present the reasons for opposition and to ask that the Regional Council immediately take a stand in opposition also.

The Town Council of Stigliano was urgently called into permanent session as a sign of solidarity and protest, and also in order to coordinate the initiatives to be taken.

Puglia Regional President's Position

Bari GAZZETTA DEL MEZZOGIORNO in Italian 1 Mar 80 pp 1, 20

[Interview with Regional President Quarta by Franco Ferorelli: "Power Plants in Puglia--Quarta: 'I asked in Exchange...for Protection of the Coats, Other Industries, More Water, Methane'--the Reasons for These Surprise Counterparts"]

[Text] The Regions have succeeded in obtaining a postponement of the nuclear power plants by the government. Committees with equal representation from the Regions, ENEL and the CNEN will discuss the "site map" anew and supplement it, to pinpoint the site localities. This, as is known, was the outcome of the meeting of the Interregional Committee held at the Ministry of the Budget, with minister Andreatta present. As a practical matter, the proposal contained in the agenda approved by the Puglia Regional Council last Tuesday was adopted. But there is a new element.

The president of the Region, Quarta, who together with vice president Romano represented Puglia on the Interregional Committee, unexpectedly presented several undebatable "conditions" on which would depend Puglia's availability for receiving the projected power plant. They involve government commitments for solution of several structural problems that Puglia has (protection of the coasts, industrial installations, water supply, methanization).

These requests were not spoken of either in the recent regional conference or in the debate in the Council. We therefore asked president Quarta several questions in order to learn more about them.

[Question] What exactly is the position of the Puglia Region?

[Answer] We put forward the detailed-study requests contained in the agenda approved by the Council, and our position was adopted. In addition, in view of the position taken by the other Regions, it seemed advisable to me to make it clear in unequivocal terms that the conditional-possibility stance taken by the Puglia Region was strictly tied to the other Regions' adopting an analogous attitude. That is, either there was the will to make, all together, a contribution to solution of the country's energy problems, and in such case Puglia would have declared itself available to receive the nuclear power plant, or else it would not be possible to count on our region, because the southern populations would not have paid an open-ended price for the industrialization of the North. I also made it clear that the definitive resolution would have to concern all the Regions together, simultaneously, without discriminatory shifts in time phases.

[Question] And the counterparts requested?

[Answer] I specified that the government also could not shirk the duty to orient public and private investment for new industrial initiatives toward the regions that were available to receive the new power plants, since it is not conceivable that nuclear installations should be built in the South while industrial expansion continues in the North. The Region's availability also had to entail particular commitments by the government to achieve several fundamental objectives of regional policy. Among these are the pilot project for protection of the Puglia coasts from heavy seas; an overall plan for methanization of Puglia; special orders from state industries for Puglia's economic operators; and a commitment by the neighboring Regions to solution of Puglia's water problems.

[Question] Why were these "counterparts" brought out all of a sudden, without prior consultation, without a mandate from the Regional Council, without the opinions of the communes concerned? And why these four, and not, for the sake of argument, others?

[Answer] These requests came out after evaluation of the position of the other Regions, both in order to make everyone aware of his own responsibilities, and to keep anyone from assuming that Puglia would take a submissive position. In addition, I made them with the intention of interpreting the opinion of the Puglia community, which I know is very interested in solution of these fundamental problems of our region.

11267
CSO: 5100

DESIGN, CONSTRUCTION FEATURES OF CAORSO NUCLEAR POWER PLANT

Milan ENERGIA NUCLEARE in English Jan 80 pp 34-51

[Text]

ABSTRACT *This article describes the main aspects of the design, shop-fabrication and site-installation of high-strength steel heavy structural embedments inserted into thick reinforced concrete walls located in the dry well of modern nuclear power stations equipped with boiling water reactors, such as the ENEL's - Ente Nazionale per l'Energia Elettrica, Italy, Caorso plant (BWR, Mark 2, 840 MW(e)), to which specific reference is made. Such massive structural units are required to withstand the pipe-whip induced loadings, as well as the time-dependent forces generated by the main active-passive equipments that are connected to the high-energy lines and are essential to safety.*

RIASSUNTO **Grandi inserti strutturali montati nel pozzo secco di impianti nucleari.** *In questo articolo vengono descritti i principali aspetti della progettazione, fabbricazione e montaggio di grandi inserti in acciaio ad alta resistenza montati su pareti spesse di calcestruzzo armato all'interno del pozzo secco di moderni impianti elettronucleari equipaggiati con reattori ad acqua bollente, quale l'impianto dell'ENEL (Ente Nazionale per l'Energia Elettrica) di Caorso (BWR, Mark 2, 840 MW(e)), cui si fa specifico riferimento. Tali massicce unità strutturali hanno la funzione di sostenere i carichi indotti da «pipe-whip» e quelli variabili nel tempo dovuti ai principali componenti attivi-passivi connessi alle linee di alta energia ed essenziali ai fini della sicurezza.*

Massive structural embedments in the dry well of nuclear installations

N. Crucitti
AMN Impianti per l'Energia - Genova (Italy)

1. GENERAL

The protection of the essential components within the drywell of modern nuclear power stations, in accordance with the safety requirements and the regulatory positions as identified in the AEC-RG. 1.46 [1], is provided through a number of pipe-whip restraints that follow the configuration of specific piping systems.

Owing to the high impact loadings generated in the case of a pipe-whip event as well as the limited room available [2] during the mechanical installation phases, sizing and shaping steel structures for supporting functions [3] require a considerable amount of engineering work.

In particular, a substantial effort may be necessary for designing the end connections of the steel beams, installed within the drywell, that terminate into adjacent civil structures since, depending upon the stress calculations as well as upon the interfaces between the civil constructor and the mechanical erector, rather complicated configurations may result as final design solutions.

A category of end connections reflecting the features identified above consists of the Reactor Pressure Vessel (RPV) reinforced concrete pedestal embedments.

Specific reference is made herein to the Caorso (Italy), BWR - Mark 2 - 840 MW(e), nuclear power station.

2 DESCRIPTION

The steel embedments of the reactor pressure vessel (RPV) pedestal (fig. 1) are massive units consisting of a formed reinforcing plate with a welded box-type attachment (fig. 2).

In order to permit possible relocation and/or addition of such embedments during progression of the mechanical design as well as of the licensing negotiations, a continuous series of 43 mm diameter anchor bolts has been embedded into the pedestal upper portion following a ~ 200 mm side squared pattern (fig. 1).

A typical embedded anchor bolt is shown in fig. 3.

The prime function of these embedments is to provide adequate structural support and anchorage for the high energy lines and associated pumps, valves, hangers, hydraulic snubbers and pipe-whip restraints, including seating to some of the radially installed beams.

All embedments shall be capable to withstand both static and dynamic loads generated by the equipments installed in the drywell, as well as the impact loads resulting from any pipe-whip situation, including the seismic induced disturbances that are likely to occur during the plant operation. The configuration of a typical massive embedded unit is shown in fig. 4 wherein the projecting bolts, the formed reinforcing plate and the cantilever attachment constituting the main structural members can be seen.

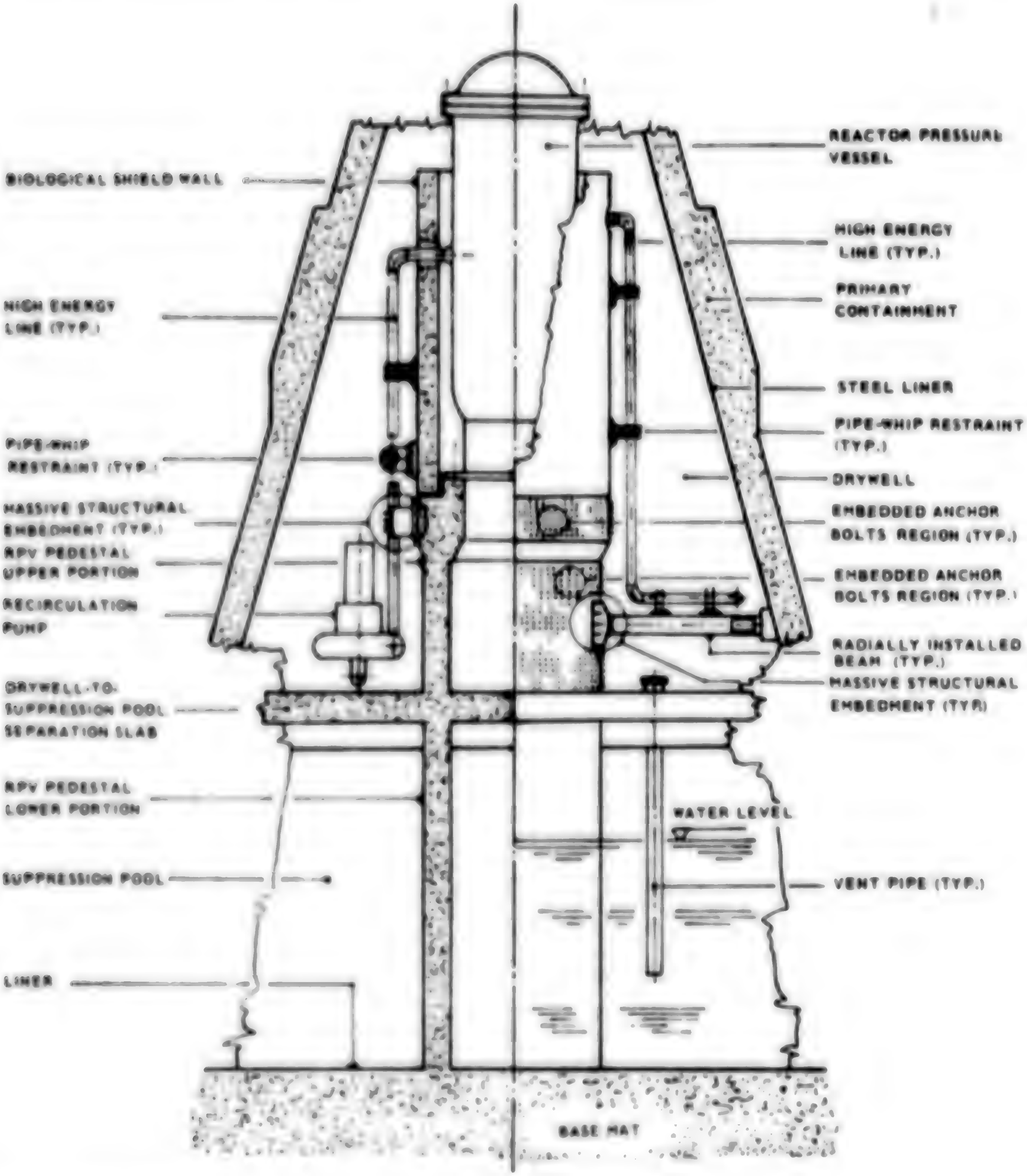

BIOLOGICAL SHIELD WALL
REACTOR PRESSURE VESSEL
HIGH ENERGY LINE (TYP.)
HIGH ENERGY LINE (TYP.)
PRIMARY CONTAINMENT
STEEL LINER
PIPE-WHIP RESTRAINT (TYP.)
PIPE-WHIP RESTRAINT (TYP.)
DRYWELL
MASSIVE STRUCTURAL EMBEDMENT (TYP.)
EMBEDDED ANCHOR BOLTS REGION (TYP.)
RPV PEDESTAL UPPER PORTION
EMBEDDED ANCHOR BOLTS REGION (TYP.)
RECIRCULATION PUMP
RADIALLY INSTALLED BEAM (TYP.)
MASSIVE STRUCTURAL EMBEDMENT (TYP.)
DRYWELL-TO-SUPPRESSION POOL SEPARATION SLAB
RPV PEDESTAL LOWER PORTION
WATER LEVEL
SUPPRESSION POOL
VENT PIPE (TYP.)
LINER
BASE MAT

Fig. 1 - Typical configuration of the reactor pressure vessel (RPV) reinforced concrete pedestal.

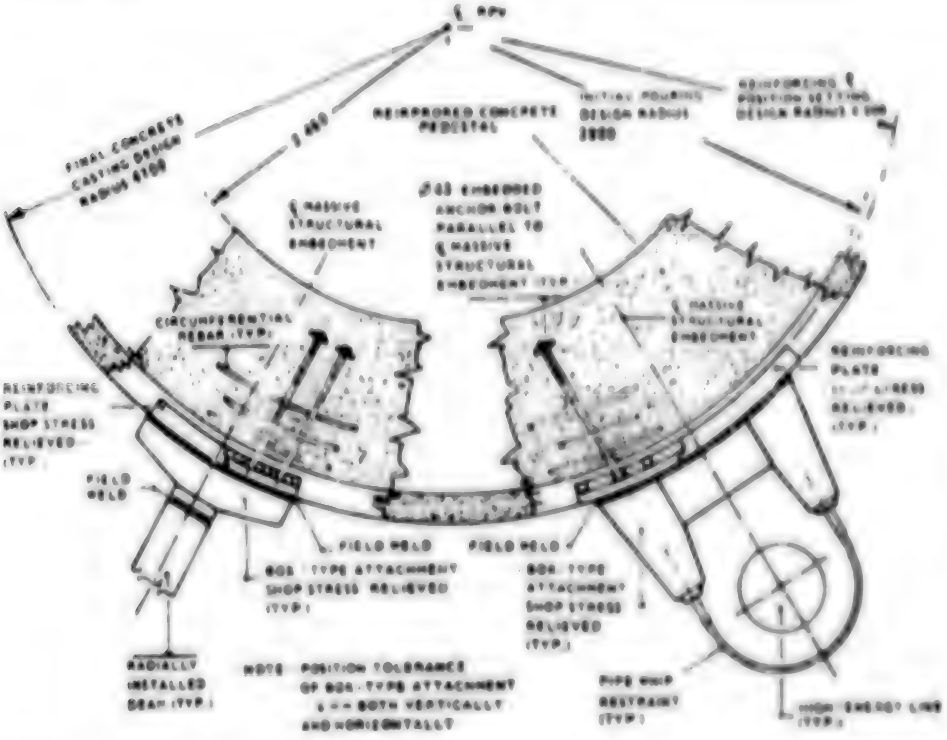

℄ RPV
FINAL CONCRETE CASTING DESIGN RADIUS
REINFORCED CONCRETE PEDESTAL
INITIAL POURING DESIGN RADIUS
℄ MASSIVE STRUCTURAL EMBEDMENT
∅ 43 EMBEDDED ANCHOR BOLT PARALLEL TO ℄ MASSIVE STRUCTURAL EMBEDMENT (TYP.)
CIRCUMFERENTIAL REBAR (TYP.)
℄ MASSIVE STRUCTURAL EMBEDMENT
REINFORCING PLATE SHOP STRESS RELIEVED (TYP.)
REINFORCING PLATE SHOP STRESS RELIEVED (TYP.)
FIELD WELD
FIELD WELD
FIELD WELD
BOX - TYPE ATTACHMENT SHOP STRESS RELIEVED (TYP.)
BOX - TYPE ATTACHMENT SHOP STRESS RELIEVED (TYP.)
RADIALLY INSTALLED BEAM (TYP.)
NOTE : POSITION TOLERANCE OF BOX - TYPE ATTACHMENT BOTH VERTICALLY AND HORIZONTALLY
PIPE WHIP RESTRAINT (TYP.)
HIGH ENERGY LINE (TYP.)

Fig 2 - Configuration of the RPV reinforced concrete pedestal massive structural embedments.

The adoption of the embedded bolt solution is useful also to provide, as a secondary function, seating for temporary scaffolding and provisional hardware necessary for positioning and installing the mechanical equipments and steel structures within the drywell. The as-built configuration of the anchor bolts and typical massive steel embedded units are shown in fig. 5.

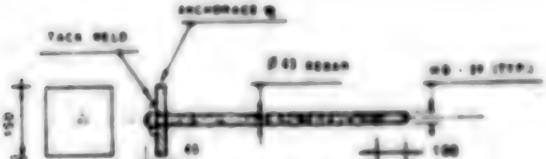


Fig. 3 - Typical ∅ 43 mm rebar anchor bolt.

3. DESIGN

3.1. STRUCTURAL DESIGN CRITERIA

The structural system which supports the pipe-whip restraints consists primarily of a series of radially oriented beams located in the drywell (fig. 1). In most cases these beams are simply supported at their outer ends by the primary containment wall to accomodate thermal expansion movements and rigidly clamped at their inner ends by the biological shield wall or the reactor pressure vessel pedestal.

All inner end connections are designed to withstand vertical, horizontal and axial loads, vertical and horizontal bending moments, torsional moments.

The radial beams are primarily designed to resist the following load categories:

— pipe-whip restraints loads

— pipe crushing impact loads

— blowdown fluid jet impingement consequent upon postulated pipe ruptures

— dead loads

— life loads.

Such load categories and their magnitude are identified and calculated through the pipe-rupture damage analyses [4] which leads to a detailed evaluation of the dynamic effects of the pipe whip [5] in order to achieve the maximum protection of specific systems, including the primary containment, in the event of a pipe rupture.

Such protection can be effected by means of an adequate structural system capable to assure a safe operation of these essential equipments that are necessary, upon the occurrence of any postulated rupture, to provide shutdown capabilities, that is:

— maintaining the ability to scram the reactor

— maintaining sufficient emergency core cooling system (ECCS)

— maintaining the primary containment integrity and isolation capability to limit the offsite radiation releases.

Such structural system is a complex system which consists primarily of a number of pipe-whip restraints, massive steel structures, honeycomb-cell energy absorbing material modules and hydraulic snubbers.

The pipe-whip restraints, as differentiated from the piping supports, are designed to function and carry loads for an extremely low probability failure in the Reactor Coolant and Pressure Boundary (RCPB).

The RCPB piping integrity does not depend on the pipe-whip restraints during normal, upset, emergency and faulted conditions as defined in article

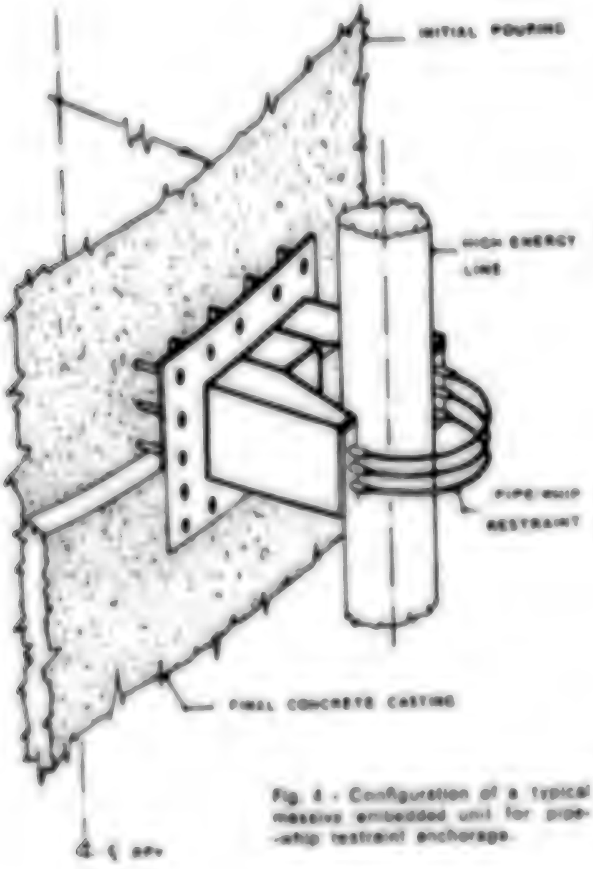


Fig. 4 - Configuration of a typical massive embedded unit for pipe-whip restraint anchorage.

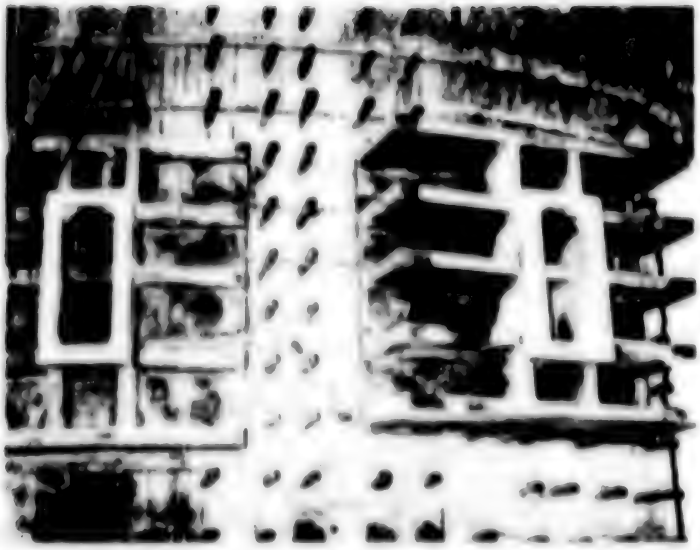


Fig. 5 - Close-up view of the anchor bolts projecting outside the RPV reinforced concrete pedestal, and typical massive structural embedded units in the as-installed condition and prior to final concrete casting.

NB-3113 of the ASME - Boiler and Pressure Vessel Code, Section 3; but it relies on the piping supports in order to maintain the actual stress level within the allowable design values, since the pipe-whip restraints shall in no way modify the RCPB piping stresses during any reactor operation mode and condition.

The pipe-whip restraints act as energy absorbing elements, and are specifically designed, fabricated, tested and installed to provide assurance that ruptured pipe movements are limited and controlled [6] so that no impact with critical equipments and missiles originated from the pipe failure are allowed. As such, the pipe-whip restraints are only subjected to an once-in-the lifetime loading and the local deformations, which occur following an impact on both the pipe and restraints, do not affect the RCPB integrity.

Therefore, for design purposes, the pipe break event is considered to give place to a faulted condition and the piping, the pipe-whip restraints and the steel structures that ultimately withstand the pipe failure induced loads are analysed accordingly.

In order to successfully perform the design of such structures, it is necessary to develop analytical methods to determine the energy dissipation in the piping systems and the pipe-whip restraints.

The dynamic effects of any pipe-whip event are to be evaluated through the following steps:

— identification of postulated break locations

— thrust-time forcing functions at the break location points

— determination of the pipe-whip restraints loadings for the design of the supporting steel structures and of the pipe deflections for use as inputs for the pipe movement study.

In most cases, the evaluation of the pipe-whip restraints loadings shows that the order of magnitude of the resulting dynamic forces is quite large for specific high energy lines and, therefore, the ability to withstand such loads in accordance with the RCPB protection requirements as identified above require highly reliable steel structures as to design, material selection, fabrication, inspection, installation and Quality Assurance.

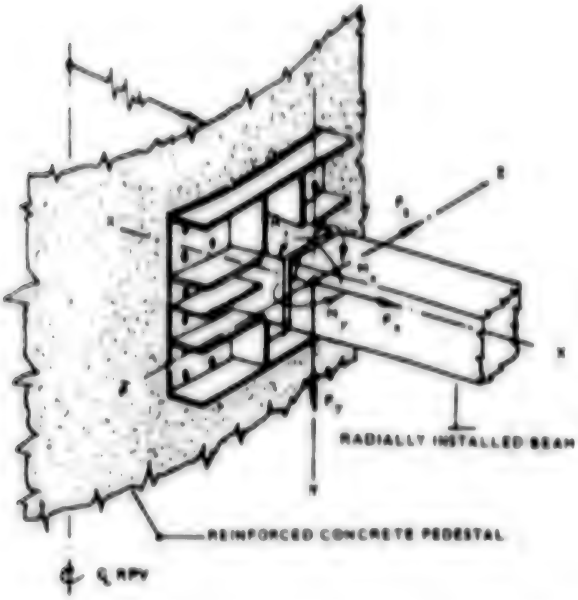


Fig. 8 - Configuration of a typical embedded unit for radially installed beam end-connection at the RPV pedestal and interface loads.

These requirements are emphasized in the areas where the radially oriented beams are to be joined, through their end connections to the civil structures, due to the presence of the steel-concrete interfaces.

The design loads for these end-connections, effected by the massive embedded box-type units as described herein, are the following,

- pipe-whip restraints loads
- pipe crushing impact loads

since the contribution of the other load categories is minimal.

3.2. DESIGN METHOD

The sizing calculations of a typical massive steel embedment, shown in fig. 6, is presented herein assuming that all anchor bolts act as tension members, the RPV pedestal cylindrical surface is considered a flat surface, all applied loads are equivalent static loads.

The design method is based on the correlations set forth in references [7, 8, 9]; however, as for the model generation and the calculation assumptions, the adopted procedure is rather conservative.

The fabrication drawings are shown in fig. 7 and the design applied loads resulting from the damage analysis of the pipe-whip restraint structural system are the following:

$$F_x = 87\ 998 \quad \text{kg} \qquad (1)$$

$$M_y = 237\ 958 \cdot 10^3 \quad \text{kg} \cdot \text{mm} \qquad (2)$$

$$F_z = 353\ 354 \quad \text{kg} \qquad (3)$$

$$M_z = 87\ 850 \cdot 10^3 \quad \text{kg} \cdot \text{mm} \qquad (4)$$

The allowable stress for the steel plates in bending is

$$\sigma_{\underset{(pl.)}{all.}} = 0.9 \times \sigma_{\underset{(pl.)}{y}} = 36 \ \text{kg/mm}^2 \qquad (5)$$

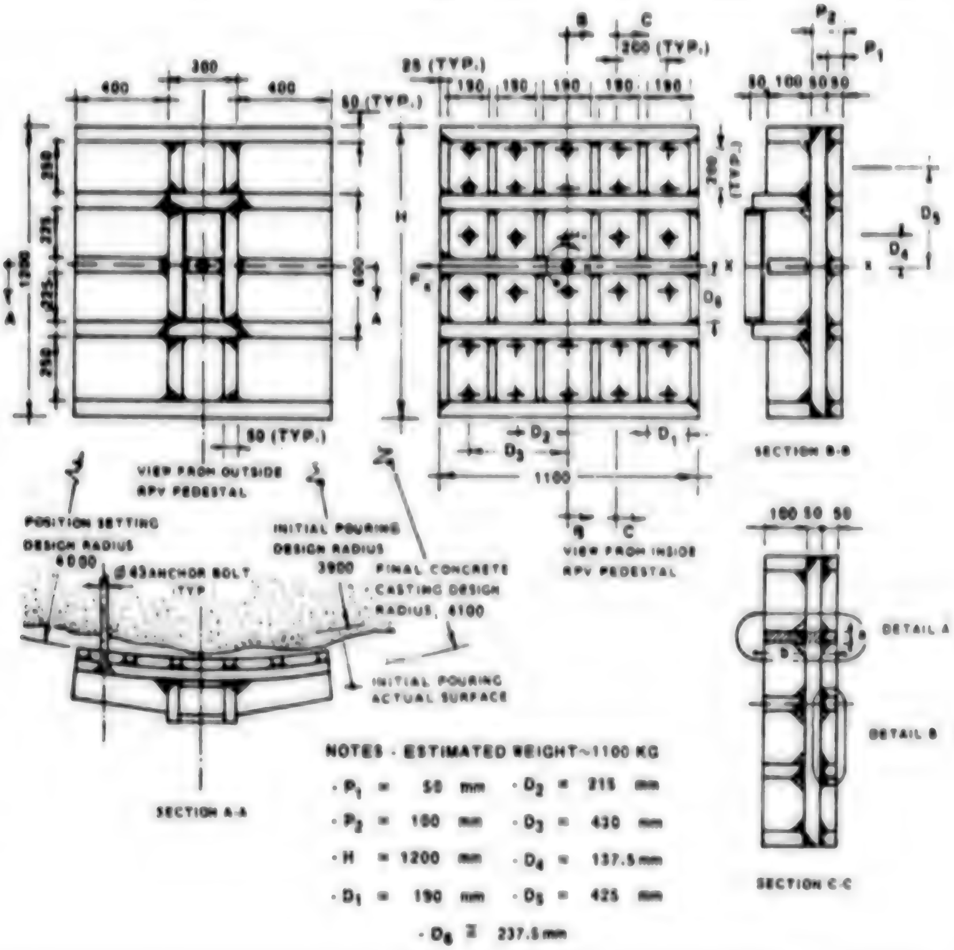
The allowable stress for the anchorage bolts in tension is

$$\sigma_{\underset{(bo.)}{all.}} = 0.9 \times \sigma_{\underset{(bo.)}{y}} = 31.5 \ \text{kg/mm}^2 \qquad (6)$$

The allowable bearing strength of the concrete is

$$\sigma_{\underset{(co.)}{all.}} = 2\,(0.85 \times \Phi \times f'_{(co.)}) =$$

$$= 2\,(0.85 \times 0.70 \times 2.8) = 3.3 \ \text{kg/mm}^2 \qquad (7)$$



300
400
400
50 (TYP.)
25 (TYP.)
190
B
C
200 (TYP.)
P2
P1
50 100 50 50
250
225
225
250
1200
600
A
H
200 (TYP.)
D5
D4
D6
X
50 (TYP.)
D2
D3
D1
1100
B
C
VIEW FROM OUTSIDE RPV PEDESTAL
VIEW FROM INSIDE RPV PEDESTAL
SECTION B-B
100 50 50
POSITION SETTING DESIGN RADIUS 6000
INITIAL POURING DESIGN RADIUS 3900
Ø 43 ANCHOR BOLT (TYP)
FINAL CONCRETE CASTING DESIGN RADIUS, 6100
INITIAL POURING ACTUAL SURFACE
DETAIL A
DETAIL B
SECTION A-A
SECTION C-C

Fig. 7 - Fabrication drawings of a typical massive structural embedded unit.

NOTES - ESTIMATED WEIGHT~1100 KG

- P1 = 50 mm
- P2 = 100 mm
- H = 1200 mm
- D1 = 190 mm
- D2 = 215 mm
- D3 = 430 mm
- D4 = 137.5 mm
- D5 = 425 mm
- D6 ≅ 237.5 mm

in the case that the bearing surface is much larger then the loaded area [7].

But, in the plate end anchorage region and assuming a rectangular stress distribution, such value should be limited to [7]

$$\sigma_{all.\,(co.)} = 0.9 \times f'_{(co.)} = 2.5 \text{ kg/mm}^2 \qquad (8)$$

3.2.1. *Reinforcing plate design*

The reinforcing plate is modelled as shown in fig. 8.

Assuming a group of 12 bolts acting as anchorage bolts, from the following equilibrium equations

$$\begin{gathered} T = C + F_a \\ \sum M_a = (C \cdot L_1) + (F_a \cdot L_2) - M_a \end{gathered} \qquad (9)$$

where

$$C = \sigma_{all.\,(co.)} \cdot (H \cdot L_1) \qquad (10)$$

and introducing the values (1), (2) and (8) into (9) and (10), it comes out

$$L_1 \cong 80 \text{ mm} \qquad (11)$$

$$T \cong 330\,000 \text{ kg} \qquad (12)$$

$$C \cong 242\,000 \text{ kg} \qquad (13)$$

Therefore the tension load per bolt is

$$\frac{T}{12} \cong 27\,500 \text{ kg} \qquad (14)$$

which is less than the anchor bolt capacity calculated using (6) and the thread geometrical data given in fig. 3.

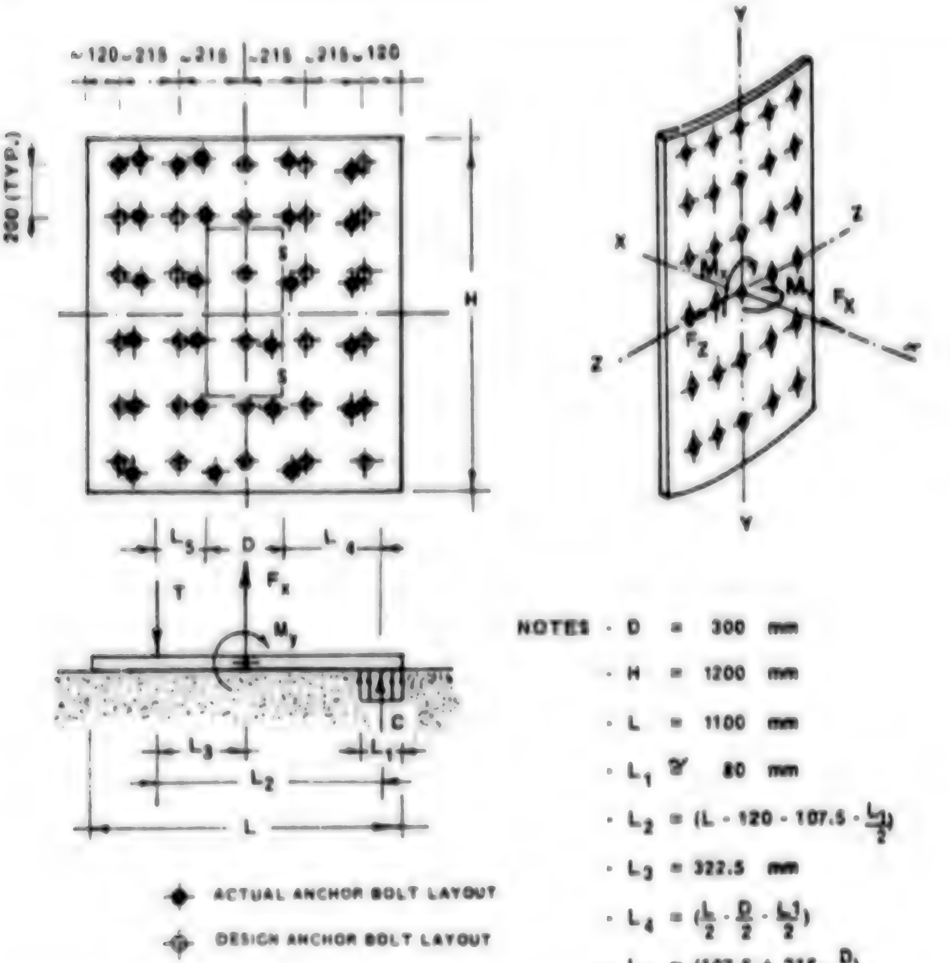


Fig. 8 - Model of the reinforcing plate.

NOTES
- $D = 300$ mm
- $H = 1200$ mm
- $L = 1100$ mm
- $L_1 \cong 80$ mm
- $L_2 = (L - 120 - 107.5 - \frac{L_1}{2})$
- $L_3 = 322.5$ mm
- $L_4 = (\frac{L}{2} - \frac{D}{2} - \frac{L_1}{2})$
- $L_5 = (107.5 + 215 - \frac{D}{2})$

The section *S-S* is checked by evaluating the bending moment

$$M_{S-S} = C \cdot L_1 \qquad (15)$$

which, using the value (13) and the dimensional data shown in fig. 8, comes out to be

$$M_{S-S} \cong 8\,700 \cdot 10^4 \text{ kg} \cdot \text{mm} \qquad (16)$$

Therefore the bending moment per stiffener (see detail *A* in fig. 7) is

$$M_{\substack{S-S\\(st.)}} = \frac{M_{S-S}}{5} \qquad (17)$$

and, using the plastic modulus, the associated stress is given by

$$\sigma_{\substack{S-S\\(st.)}} = \frac{M_{\substack{S-S\\(st.)}}}{\dfrac{b\,h^2}{4}} \qquad (18)$$

Introducing (17) and the geometrical data shown in detail *A* of fig. 7 into (18), it is obtained

$$\sigma_{\substack{S-S\\(st.)}} = 34.5 \text{ kg/mm}^2 \qquad (19)$$

that is less than (5).

The bending moment due to tension in the anchor bolts is evaluated by

$$M_{\underset{(\text{ten.})}{x-x}} = T \cdot L_0 \qquad (20)$$

that gives, using (12) and the geometrical data given in fig. 8

$$M_{\underset{(\text{ten.})}{x-x}} \cong 5\,700 \cdot 10^4 \ \text{kg} \cdot \text{mm}$$

that is less then (16).

3.2.2. *Shear lug design*

The polar moment of inertia about the *x-x* axis of the bearing areas is calculated through the following equation

$$I_{x-x} = D_1^2 (D_1 \cdot P_1) \cdot 10 + D_2^2 (D_1 \cdot P_1) \cdot 10 +$$

$$+ D_3^2 (D_2 \cdot P_1) \cdot 12 + D_4^2 (D_2 \cdot P_1) \cdot 12 \qquad (21)$$

which, introducing in (21) the geometrical data given in fig. 7, gives

$$I_{x-x} \cong 50\,300 \times 10^6 \ \text{mm}^4 \qquad (22)$$

The bearing stress on concrete results from this correlation,

$$f'_{\underset{(\text{ec.})}{\text{bea.}}} = \frac{F_s}{S_{\underset{(\text{ec.})}{\text{bea.}}}} \pm \frac{M_s \cdot D_4}{I_{x-x}} \qquad (23)$$

where the bearing surface is given by

$$S_{\underset{(\text{ec.})}{\text{bea.}}} = H \cdot P_2 + 20\,(D_2 \cdot P_1) \qquad (24)$$

Substituting the dimensions given in fig. 7 into (24) and using the values (3), (4), (22), and (24) in (23), it results

$$f'_{\underset{(\text{ec.})}{\text{bea.}}} \cong 1.7 \ \text{kg/mm}^2 \qquad (25)$$

which is less than (8).

Assuming conservatively that each 25 mm thick shear lug (see detail *B* of fig. 7) has one long clamped edge and three free edges, the maximum stress in such shear lug due to the bearing stress (25) is

$$\sigma_{(\text{lug})} \cong 20 \ \text{kg/mm}^2 \qquad (26)$$

that is less than (5).

4. FABRICATION

The key problems to be considered upstream, during and downstream the shop-fabrication are the following:

- material selection
- joint design
- welding method
- post-weld heat treatment
- non-destructive examination

Since each embedment requires a very large amount of welding combined with a considerable number of adjacent lugs and brackets obtained from thick rolled plates, prevention and avoidance of lamellar tearing cracks is one of the main design objectives.

The material selected for each embedment was IDROTUB-56-F, normalized, fully killed and made to fine grain practice carbon-manganese steel with the following chemical composition,

Carbon	0.80 % (max)	(27)
Manganese	1.60 % (max)	
Silicon	0.40 % (max)	
Sulphur	0.035% (max)	
Phosphorus	0.030% (max)	
Niobium	0.080% (max)	
Vanadium	0.080% (max)	
Nitrogen	0.015% (max)	
Chromium	0.40 % (max)	

at ladle analysis, to produce plates up to 70 mm thickness with the following mechanical properties

$$\sigma_{\underset{(\text{pl.})}{t}} = 56 \ \text{kg/mm}^2 \ (\text{min})$$

$$\sigma_{\underset{(\text{pl.})}{y}} = 40 \ \text{kg/mm}^2 \ (\text{min}) \qquad (28)$$

$$A_{(5)} = 21\% \qquad (\text{min})$$

In addition each plate was impact tested in accordance to the ASME-Boiler and Pressure Vessel Code, Section 3, Class B, to the following Charpy-Vee values,

$K_v = 3.6$ kg · m/cm², minimum average value of 3 specimens (29)

$K_v = 2.7$ kg · m/cm², minimum value of 3 specimens as determined by longitudinal 10 × 10 × 55 mm test specimens according to the ASTM-A-370 standard, at 0 °C temperature.

Each plate was also 100% visually inspected and ultrasonicly tested according to the ASTM-A-435 standard.

Therefore, the minimization of lamellar tearing susceptibility was obtained by increasing the short-transverse ductility of the rolled plates reducing the inclusion content, maximizing the grain refinement and using pulse-echo ultrasonic testing to detect laminations.

All parts were flame-cut and all flame-cut weld preparations were ground for ~ 1 mm depth at least.

All welds were made by SMAW manual process; appropriate weld sequence and adequate bracing were used to prevent warping as well as undue deformations, since, in some cases, the predicted weld shrinkage was ~ 2.5 mm.

The welding material and bead sequence were selected in order to meet the Charpy-Vee impact properties (29) on both weld notch and heat-affected zone using the method set forth in the ASTM A-370 standard, at a test temperature equal to 0 °C.

The stick used for the whole fabrication was low-hydrogen Siderotermica-Supercito Basico 60, preheat-interpass temperature was 180-200 °C for a distance of ~ 80 mm minimum on each side of the weld, root passes were made with a 3.25 mm diameter stick and metal built-up was made with a 4 mm diameter stick.

All double-side full-penetration welds had root gauged before back welding.

Single-side full penetration weld had back cover-passes or 5 mm thick back-strip which also acted as driving fit. The back-strip, wherever used, was continuous. All weld end-preparations were fully visually examined. Additional provisions were incorporated into the fabrication design as the bevel orientation, preference for double-side balanced joints, small volume welds (fig. 9).

Each reinforcing plate and the corresponding attachment were shop-preassembled for the purpose of controlling dimensions and fit-up check prior to shipment to the site.

Each reinforcing plate and the corresponding attachment, shown in fig. 2, were independently stress relieved to a temperature 600-625 °C after complete shop-fabrication. Holding time was 1 h/25 mm thickness, temperature gradient was 150 °C/h. for both heat-up and cool-down to 250 °C, below which each assembly was exposed to the air.

Each approximately 1/2 weld deposit thickness was 100% MP inspected for plate thickness ranging from 20 mm up to 50 mm, keeping constant the preheat-interpass temperature.

All completed welds were 100% MP examined after post-weld heat treatment.

Welding procedure qualification tests have been run in accordance to the ASME-Boiler and Pressure Vessel Code, Section 9, Welding and Brazing qualification, along with specific requirements as mentioned above.

The bead sequence, electrode diameter and HV_{10} hardness measurements resulting for macro-examinations of typical overhead and horizontal position welds are shown in fig. 10.

A typical massive embedded end-connection of a radially installed beam is shown in fig. 11.

5. INSTALLATION

Since the site installation of all massive embedments had to be done in very congestioned areas, wherein accessibility conditions might have been critical, the following detailed procedure was studied, and applied through an adequate surveillance program:

1. Identify on the RPV pedestal the area associated to each embedment.

2. Mark-up clear and visible horizontal and vertical axis on the RPV pedestal.

3. Mark-up the peripheral edges of each reinforcing plate on the RPV pedestal.

4. Cut bolts within the area as defined per step no. 3 to the required 4 030 mm radius (fig. 7).

5. Check whether the periphery of each reinforcing plate has sufficient margin to permit complete welding of all bolts located nearby the edges. Minimum distance between the reinforcing plate

edges and the peripheral bolts centerline should be ~ 100 mm

6. Set adequate template upon the area per step no. 3, slightly adjust if necessary, to suit the requirements per step no. 5, then mark up carefully each bolts on the template

7. Re-identify carefully both horizontal and vertical axis on the template

8. Scribe map per step no. 6 and axis per step no. 7 on the corresponding reinforcing plate outer surface

9. Drill and machine holes on the reinforcing plate to the geometry shown in fig. 12.

10. Set and align in position the reinforcing plate

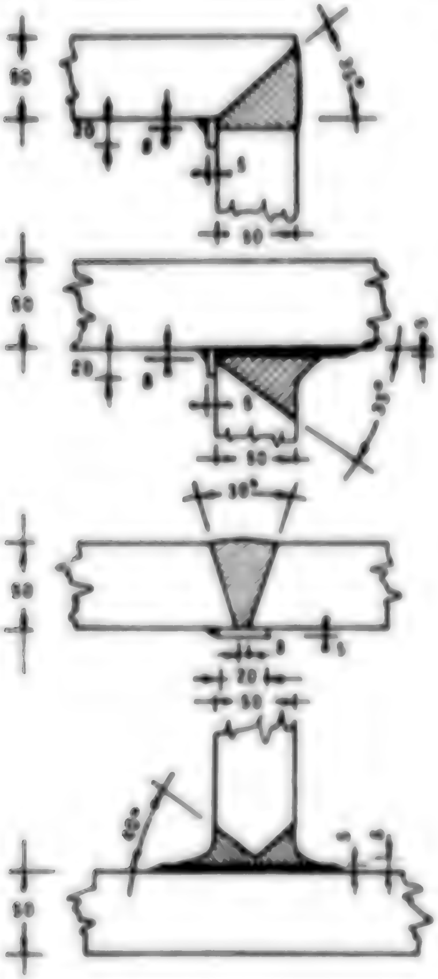


Fig. 9 - Typical weld joints.

11. Commence welding corners bolts (see fig. 13)

12. Continue welding bolts (see fig. 13)

13. 100% MP test

14. Grind welded areas flush to the reinforcing plate outer surface

15. Clean exposed metal surfaces.

16. Re-check location of both horizontal and vertical axis per step no. 8

17. Set and align in position the box-type attachment.

18. Check for planarity, orientation, position tolerance and radial distance of the cantilever attachment (see fig. 2)

19. Commence welding the attachment to the corresponding reinforcing plate.

20. 100% MP test

21. Clean exposed metal surfaces

22. Roughen initial pouring surface by bush hammering and cast final concrete annulus (see fig. 2)

22. Re-clean exposed metal surfaces

All field welding was a non-stop welding until at least 1/2 weld deposit was completed. The reinforcing plate-to-box type attachment full penetration weld was not stress-relieved. The most critical phase of the site-installation was the reinforcing plate-to-bolt welded connection that was subjected to the following mandatory requirements

— the concrete temperature should not exceed 70 °C during welding.

— root-gap between the bolt and the hole should not be less than 7 mm, to allow for smooth insertion of the reinforcing plate, since many embedded bolts were misaligned.

— the pull-out force of the weld should not be less than the tensile load of the bolts.

Each anchor bolt was fabricated in accordance with the ASTM-A-615 Grade 60, from deformed rebar having the following chemical composition

Carbon	0.32 % (max)
Manganese	1.25 % (max)
Phosphorus	0.05 % (max)
Sulfur	0.05 % (max)

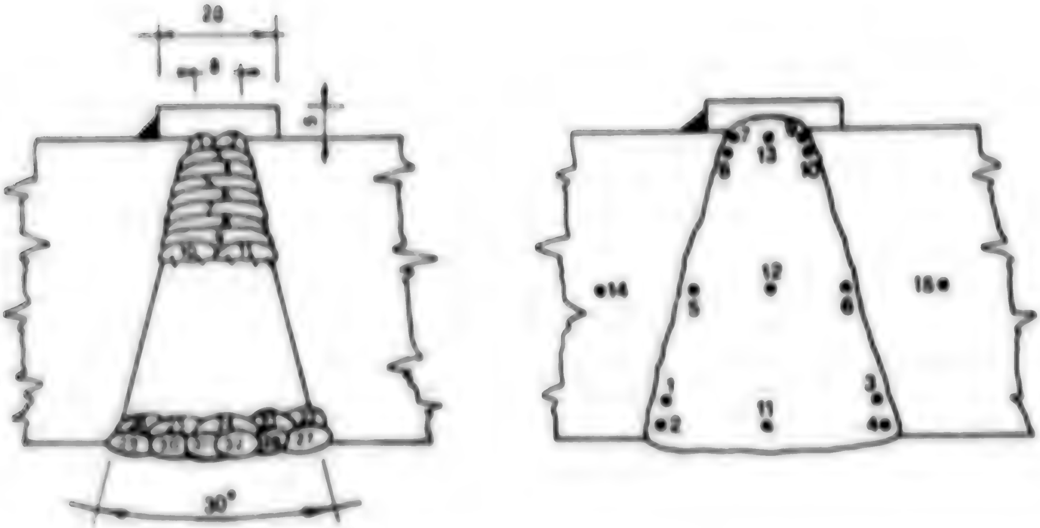


PLATE THICKNESS 50 mm		HV_{30}					kv - kg m/cm²			
		HAZ			NOTCH	BASE METAL	HAZ		NOTCH	
BEAD Ø	STICK Ø mm	1 - 2 3 - 4	5 - 6	7 - 8 9 - 10	11 - 12 - 13	14 - 15	AVERAGE OF 3 SPECIMENS	MINIMUM OF 3 SPECIMENS	AVERAGE OF 3 SPECIMENS	MINIMUM OF 3 SPECIMENS
1 ÷ 2 3 ÷ 32	3.25 4	289	225	251	213	184	6.1	5.95	6.1	6

OVER HEAD POSITION

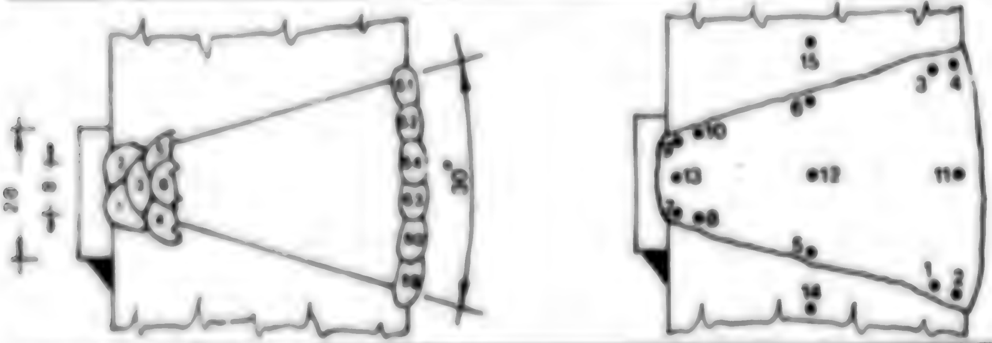


PLATE THICKNESS 50 mm		HV_{30}					kv - kg m/cm²			
		HAZ			NOTCH	BASE METAL	HAZ		NOTCH	
BEAD Ø	STICK Ø mm	1 - 2 3 - 4	5 - 6	7 - 8 9 - 10	11 - 12 - 13	14 - 15	AVERAGE OF 3 SPECIMENS	MINIMUM OF 3 SPECIMENS	AVERAGE OF 3 SPECIMENS	MINIMUM OF 3 SPECIMENS
1 ÷ 3 4 ÷ 64	3.25 4	281	258	253	220	181	9.9	8.9	9.15	8.3

HORIZONTAL POSITION

Fig. 10 - Bead sequence, hardness measurements, and impact values on weld-notch and heat-affected zone of typical overhead and horizontal position welds after stress-relieving.

Fig. 11 - Typical massive embedded end-connection of a radially installed beam.

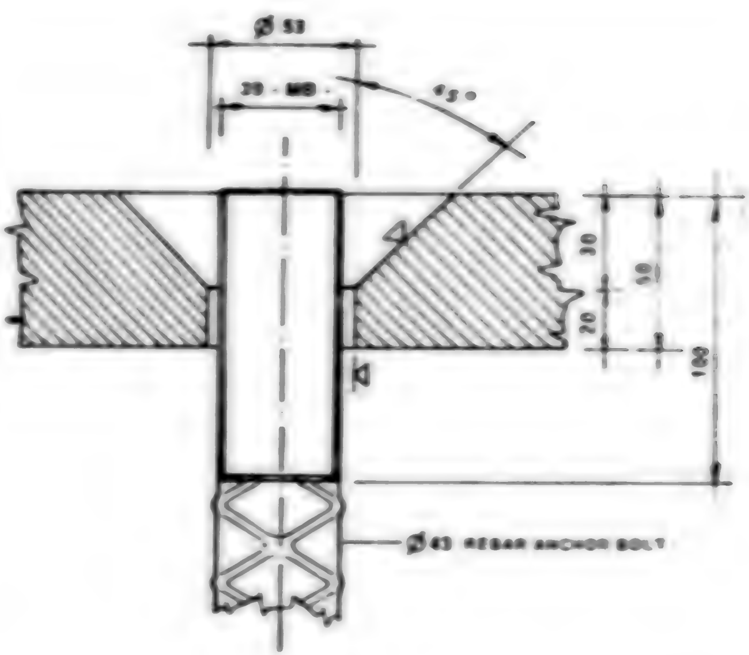


Fig. 12 - Configuration of the reinforcing plate-to-Ø 43 mm rebar anchor bolt joint.

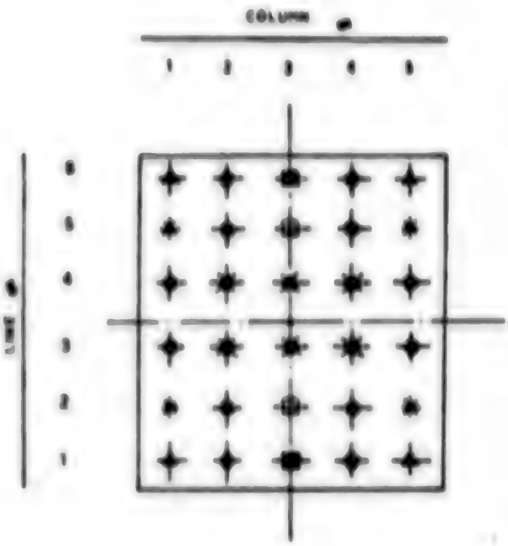


Fig. 13 - Sequential procedure for field welding the reinforcing plate to the embedded anchor bolts (conceptual).

WELD SEQUENCE		WELD IDENTIFICATION	
SYMBOL	Nº	LINE	COLUMN
✦	1	2 5 5 2	2 4 2 4
✦	2	6 1 1 6	1 5 1 5
✜	3	5 2	3 3
◆	4	4 3 3 4	1 5 1 5
■	5	4 3	3 3
✹	6	4 3 3 4	2 4 2 4
✦	7	6 1	3 3
✦	8	6 1 1 6	2 4 2 4
✳	9	5 2 5 2	1 5 5 1

at ladle analysis, and the following mechanical properties

$$\sigma_{r\,(20^\circ)} = 49 \text{ kg/mm}^2 \text{ (min)}$$

$$\sigma_{s\,(20^\circ)} = 35 \text{ kg/mm}^2 \text{ (min)}$$

$$A_{5d} = 16\% \qquad \text{(min)}$$

The configuration of the bolt-to-reinforcing plate joint is shown in fig. 12; the lateral surface of the portion of bolt penetrating the plate is threaded to achieve complete fusion.

For site-welding low-hydrogen FOX-EV-50 electrodes were used.

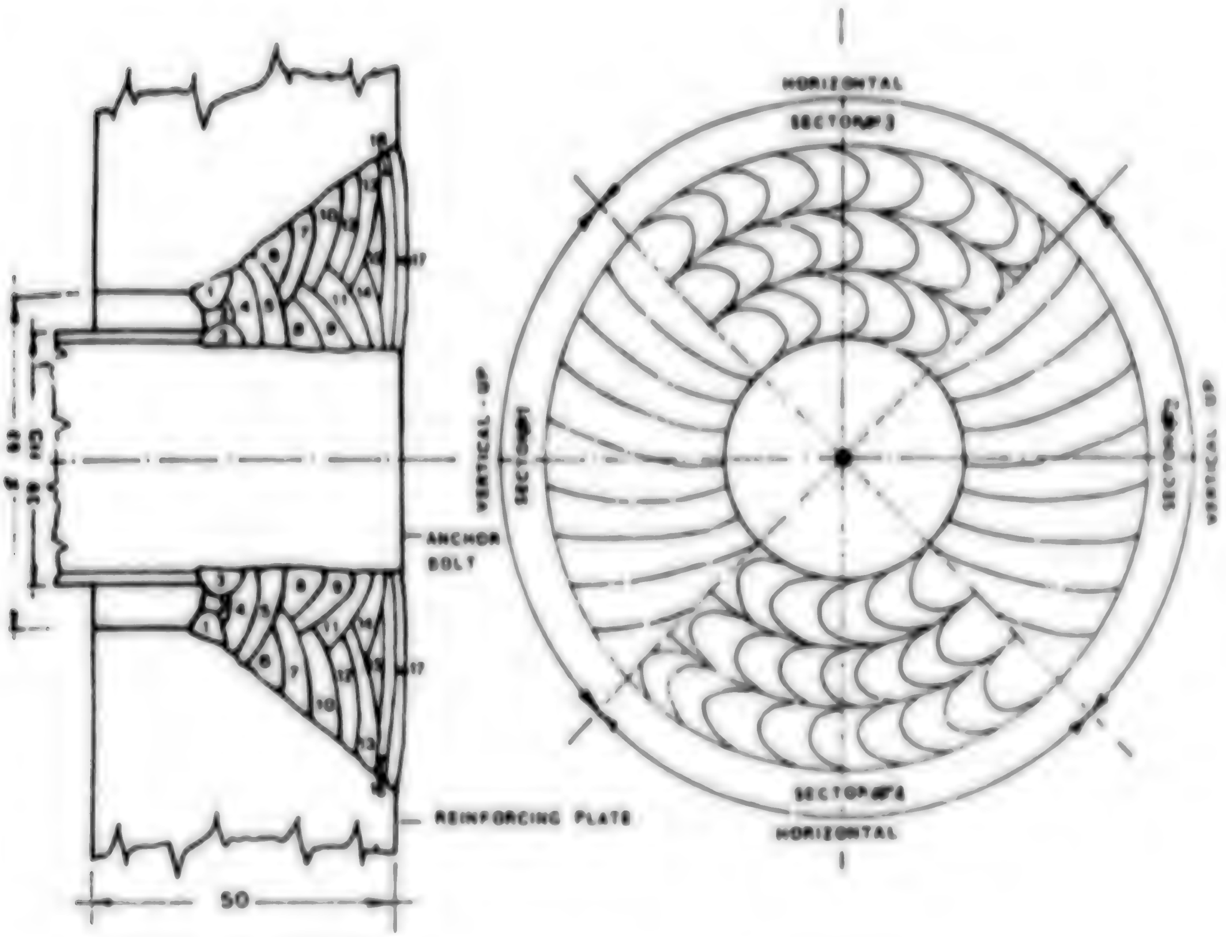
Bead sequence and technique are shown in fig. 14.

Preheat-interpass temperature was 100 °C and was closely controlled during welding, and achieved using a flame whose orientation never matched the bolt outer extremity. Extensive hardness measurements, lateral bending and pull-out tests along with macro-examinations confirmed the full soundness and ductility of both weld notch and heat-affected zone.

The macro-etched section is shown in fig. 15 and the HV_{10} hardness values are shown in fig. 16.

A lateral bending test was run on two samples machined from each assembly as shown in fig. 17 and led to acceptable results.

Pull-out tests, along with bending tests and macro-examinations, were successfully performed.



BEAD #	STICK Ø mm	BEAD SEQUENCE
1 - 2 - 3 4 ÷ 17	3.25 4	DEPOSIT WELD LAYERS ON SECTORS 1 - 2 PRIOR TO THE CORRESPONDING LAYERS ON SECTORS 3 - 4

Fig. 14 - Bead sequence of a typical Ø 43 mm anchor bolt-to-reinforcing plate weld.

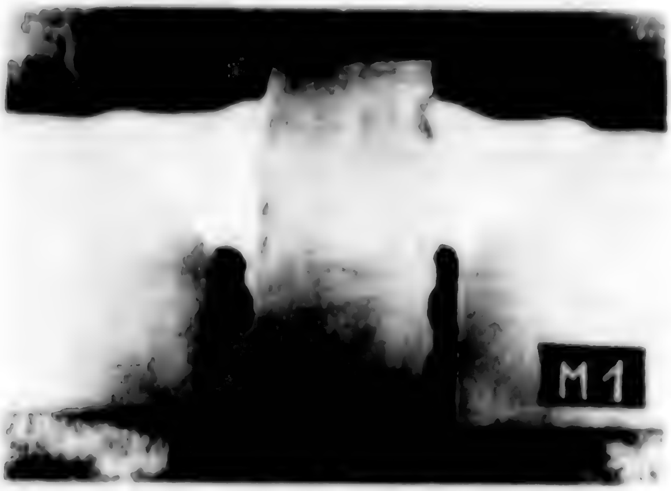


Fig. 15 - Macroetched section of a typical anchor bolt-to-reinforcing plate joint.

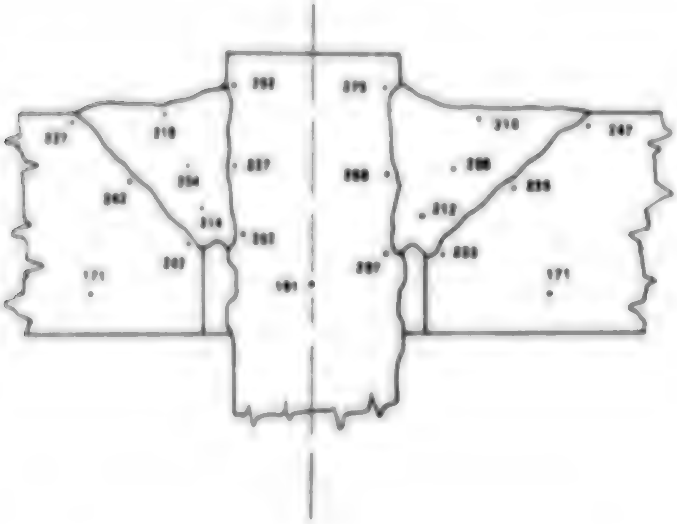


Fig. 16 - Hardness measurements on both weld-notch and heat-affected zone of a typical anchor-bolt-to-reinforcing plate joint.

TABLE 1

PULL-OUT TEST RESULTS

Sample	Applied stress (kg/mm^2)		Rebar steel mechanical properties (kg/mm^2)		Failure location
	tensile	yielding	tensile (min)	yielding (min)	on bolt
1	67	41	49	35	25 mm from anchorage plate
2	61	38			230 mm from anchorage plate

The pull-out tests run on two full-size samples as shown in fig. 18, gave the results shown in tab. 1, that are consistent with the requirements specified above.

Site welding of the anchor bolts to the reinforcing plate, prior to positioning the box-type attachment, is shown in fig. 19.

6. CONCLUSIONS

The massive steel embedments as described herein constitute an unusual plant feature from design and installation view points. The adoption of heavy welded units is typical of modern nuclear structures, that are required to withstand the high impact loads resulting from the design criteria and

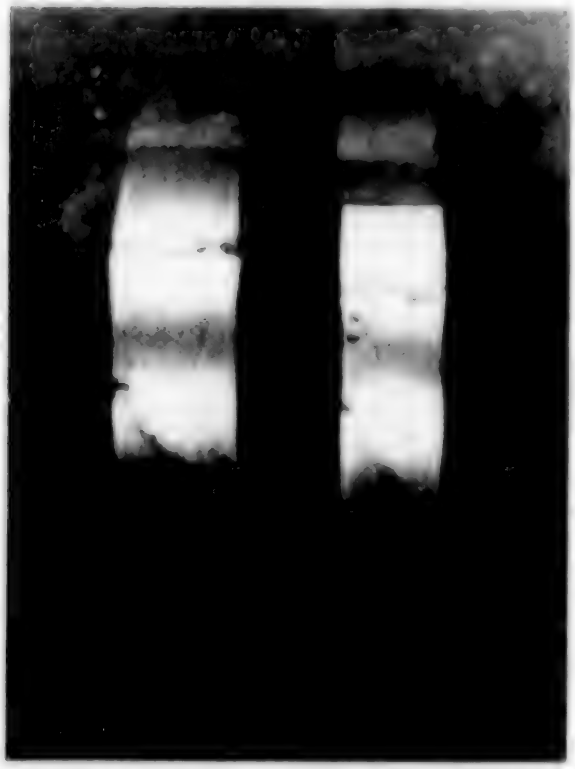


Fig. 17 - Bend test specimens cut from a typical anchor bolt to reinforcing plate joint

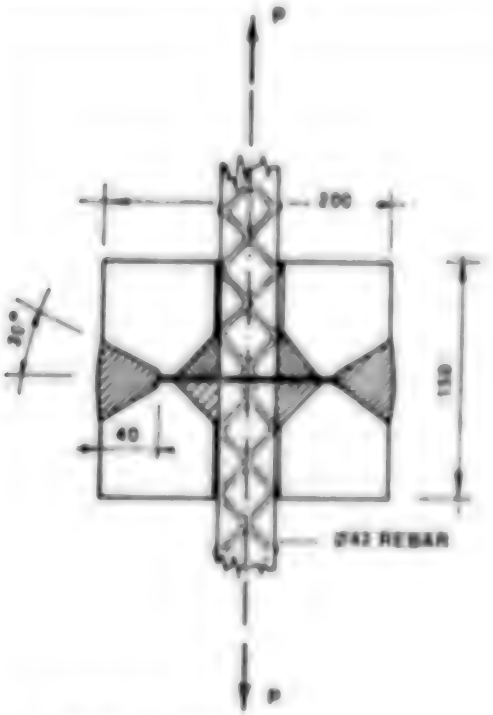


Fig. 18 - Pull-out test assembly

Fig. 18 - [illegible]

the regulatory requirements governing the protection of all safety-related equipments within the drywell from the consequences of any pipe failure occurrence. In the specific project referred to in this paper (Caorso, BWR, Mark 2, 840 MW(e)) the maximum dynamic forces rise up to 680 000 kg, as determined by the pipe whip damage study.

Any assessment on the piping integrity criteria and the piping routes within the drywell always requires a considerable period of time, which overlaps the time intervals necessary for the civil construction and the mechanical installation critical phases. Therefore the embedded bolts solution allows decoupling the most critical design activities from the most critical site-construction activities. However, in such occurrence, design conservatism and realistic engineering judgment are required to achieve a reasonable return-on-investment and compensate for the additional costs suffered for redundancy and possible deviation from the conceptual design previously established.

Design conservatism, i.e. consideration of plasticity, is also necessary in the specific embedded anchor bolt solution since positioning 45 mm bolts into a high steel density cylindrical reinforced concrete wall, like the RPV pedestal, may lead to an alignment not fully consistent with the pattern geometrical requirements set-forth in sect. 2 and shown in figs. 7 and 8. In the specific project referred to above ~ 3800 anchorage bolts and ~ 85 tons rolled plates were used for the ~ 48 embedments installation and fabrication.

The average weight of each embedment is ~ 5200 kg (large size), ~ 2400 kg (medium size), ~ 600 kg (small size). It should be noted that the dry well and, generally speaking, the primary containment, are very congestioned areas; therefore they are very sensitive to both design changes and licensing delays that drastically affect the project master schedule as well as the installation phases and procedures.

The reinforced concrete structures, i.e. the RPV pedestal, proved to be very versatile to changes without causing serious delays and without affecting the required quality level for such structure.

The use of material having good impact properties is required since each part of the pipe-whip structural system is, to a certain extent, an energy dissipating member for which ductility is one of the design requirements.

In order to successfully complete the design of the reactor and containment system it is necessary to incorporate all pipe failure protection structures, including the massive steel embedded units as described in this paper, into the early stages of the nuclear island layout.

Such layout must be developed through high engineering evaluation, so that potential conflicts arising from the changes occurring during the design progression and licensing negotiations be eliminated using flexible design solutions. ■

Manuscript received November 22, 1979

LIST OF SYMBOLS

F_x	kg	Load applied in the *x-x* direction
F_z	kg	Load applied in the *z-z* direction
M_z	kg mm	Torsional moment applied about the *z-z* axis
M_y	kg mm	Bending moment applied about the *y-y* axis
$\sigma_{all\,(st.)}$	kg/mm^2	Allowable bending stress for steel plates
$\sigma_{all\,(ab.)}$	kg/mm^2	Allowable tension stress for anchor bolts
$\sigma_{all\,(co.)}$	kg/mm^2	Allowable bearing stress for concrete
Φ		Capacity reduction factor of the concrete
$f'_{(co.)}$	kg mm^2	Specified compressive strength of the concrete
M_x	kg mm	Bending moment applied about the *x-x* axis
C	kg	Reaction force of concrete
T	kg	Reaction force of the anchor bolts
M_{S-S}	kg mm	Bending moment on section *S-S* due to *C*
$M_{S-S\,(st.)}$	kg mm	Bending moment on each stiffener of section *S-S* due to M_{S-S}
$M_{S-S\,(ab.)}$	kg mm	Bending moment at section *S-S* due to *T*
$\sigma_{S-S\,(st.)}$	kg/mm^2	Maximum bending stress on each stiffener of section *S-S* due to $M_{S-S\,(st.)}$
I_{z-z}	mm^4	Polar moment of inertia about *z-z* axis.
$f'_{bo\,(co.)}$	kg/mm^2	Bearing stress on the concrete
$S_{tot.\,(co.)}$	mm^2	Total bearing surface of the concrete
$\sigma_{(sg.)}$	kg · mm^2	Maximum bending stress on shear lug

references

[1] AEC: *Regulatory Guide No. 1.46 - Protection against pipe-whip inside containment.*

[2] N. CRUCITTI: *Construction features of the Caorso nuclear power station Mark 2 primary containment.* Energia Nucleare, Vol. 24, No. 3, March 1977.

[3] N. CRUCITTI: *Design, construction and erection of the biological shield-wall for the Caorso nuclear power station.* Energia Nucleare, Vol. 25, No. 2, February 1978.

[4] F. J. MOODY: *Maximum flow-rate of a single component two phase mixture.* Journal of heat transfer. Transactions of the ASME. Series C. Vol. 87, February 1965, page 134.

[5] R. W. GREGORY, M. P. PAIDOUSSIS: *Unstable oscillations of tubular cantilever conveying fluid.* Proceedings of the Royal Society, Series A, Vol. 293, August 1966.

[6] J. B. HUMPHREYS: *Plastic deformation of impulsively loaded straight clamped beam.* Journal of applied mechanics, Paper no. 64-WA-APM-17.

[7] ACI 318: *Standard. Building Code Requirements for reinforced concrete,* 1971.

[8] AISC: *Manual of steel construction,* 1970.

[9] O. W. BLODGETT: *Design of welded structures.* J. F. Lincoln Arc welding foundation - Cleveland, Ohio, 1966.

CSO: 5100

GOVERNMENT GIVES LIMITED OPERATION GO AHEAD TO N-PLANT

Stockholm DAGENS NYHETER in Swedish 2 Apr 80 p 6

[Article: "Forsmark 2 and Ringhals 4. Limited Authorization Given for Operation"]

[Text] The government gives limited authorization for operating the Forsmark 2 and Ringhals 4 nuclear reactors. The authorization is given in accordance with the condition law but will be valid only through 1986. According to what TT [Swedish Newspapers' Wire Service] has found out, the government made that decision on 10 April.

This is clear since the National Power Board on Tuesday gave its supplement to the application for authorization to load Forsmark 2 and Ringhals 4.

The Swedish Nuclear Fuel Supply (SKBF) has in recent days also been successful in extending the reprocessing agreement with the French Cogema. It now involves reprocessing of 672 tons of spent nuclear fuel for 10 years as against 620 tons previously.

But this is not sufficient for more than 5 years operation of Forsmark 2 and 4 years operation of Ringhals 4.

So here is the situation for the six reactors which are allowed to start according to the result of the national referendum:

Forsmark 1 received authorization for loading with nuclear fuel from the Nuclear Power Inspection (SKI) on Tuesday. The loading will thus take place on 10 April, and then the test operation will last 1 year. The National Power Board hopes to start commercial operation already before the end of the year.

Ringhals 3 will be loaded on 1 July if SKI gives the go-ahead. Commercial operation will be started at the beginning of 1981.

Forsmark 1 and Ringhals 3 will be allowed to operate through 1990 in accordance with the authorization from the Liberal Party starting this summer.

Forsmark 2 will be loaded at the end of 1980 and will be placed in commercial operation in October of 1981.

Ringhals 4 will be loaded at the end of 1981 and at the beginning of 1982, and commercial operation will start in November of 1982.

Gives 22 tWh

The four reactors produce a total of 22 tWh (billion kilowatt hours) annually.

The total production of electric power was 92.4 tWh in 1979.

According to the plans, Forsmark 3 will stand ready in 1985 and Oskarshamn 3 in 1986. Both of them are then expected to have cost approximately 50 billion kronor. They will produce a total of 12 tWh annually.

The recently expanded Cogema agreement covers the reprocessing of 672 tons of spent nuclear fuel. Of this 361 tons covers 10 years operation of Forsmark 1 and Ringhals 3.

Some 150 tons cover the operation of Forsmark 2 and Ringhals 4 through 1986. The remaining 160 tons cover the nuclear reactors in Oskarshamn and Barseback.

Within a couple of years a new extended agreement with Cogema about reprocessing or a parliamentary decision about direct storage without reprocessing will be required.

In this way authorization for operation can also be given for Forsmark 3 and Oskarshamn 3. In addition, authorization can be given for Forsmark 2 and Ringhals 3 to extend operation after 1986.

8958
CSO: 5100

NUCLEAR AGENCY ORDERS ACCIDENT STUDY BEFORE LOADING

Stockholm DAGENS NYHETER in Swedish 3 April p 11

[Article: "Swedish Nuclear Power Inspection about Ringhals 3: Report on Accident Risks before Loading"]

[Text] The Ringhals 3 nuclear reactor cannot be loaded with nuclear fuel before the owner, the State Power Board, has reported on the consequences of hydrogen gas explosions in the reactor containment. This is what SKI [Swedish Nuclear Power Inspection] has decided.

"When the report requested is ready, SKI will decide as soon as possible whether the safety margins in Ringhals 3 are adequate or whether they must be improved," says the SKI chief, Professor Lars Nordstrom.

The demands by the SKI will be reported to the government on Wednesday. The background is the Harrisburg accident and the reactor safety report. As we know, at Three Mile Island, outside Harrisburg, a hydrogen gas bubble was formed, which could have broken the reactor containment if it had exploded. If that happened, large quantities of radioactivity would have been spread in the environment.

Ringhals 2, 3 and 4 are of the same pressurized water type as the Three Mile Island reactor. As a consequence of the accident, the three Ringhals reactors containment structures have been equipped with safety valves, which will be able to release hydrogen gas in order to prevent explosions.

The government has given authorization in accordance with the condition law and the council room law for loading Ringhals 3. According to the plans by the State Water Board, the loading will take place on 1 July. But SKI does not have a report on the consequences of hydrogen gas explosions and the risk that explosions of this type will break the containment structure. Loading will not be permitted by SKI until the report has been received and approved.

The State Power Board was reminded by SKI about the possibility of filling the containment structure with nitrogen gas, which prevents explosive hydrogen gas from forming. That possibility will also be taken up in the State Power Board report.

8958
CSO: 5100 END

SELECTIVE LIST OF JPRS SERIAL REPORTS

WORLDWIDE SERIAL REPORTS

WORLDWIDE REPORT: Environmental Quality
WORLDWIDE REPORT: Epidemiology
WORLDWIDE REPORT: Law of the Sea
WORLDWIDE REPORT: Nuclear Development and Proliferation
WORLDWIDE REPORT: Telecommunications Policy, Research and Development

END OF
FICHE
DATE FILMED

6 June '80